AMERICAN JOURNAL OF OPHTHALMOLOGY

VOLUME 29 JULY, 1946 NUMBER 7

THE SCLERAL-RESECTION (EYEBALL-SHORTENING) OPERATION*

DERRICK VAIL, M.D.
Chicago

Before developing the thesis of this address, I should like to try to express my gratitude and humble thanks for the very great honor of being invited to give the de Schweinitz Lecture in the year of victory over our enemies and before this distinguished group of friends and colleagues. I have never approached a task with more diffidence and humility than I have this present one. How can one adequately pay tribute to the many-sided man whose name this lectureship bears? How can one sufficiently express his appreciation for this genius of our time, whose qualities, talents, and kindly influence live in our thoughts and deeds, whose monument is everywhere in our libraries, in our daily work, and in our hearts? There is no one who deserves more respect and admiration than this man of kind manners, the ophthalmic surgeon of exquisite delicacy, the master of neatness and tidiness in his work, the leader of ethical practice, the beloved preceptor of notable pupils, and the author of numerous and living contributions of note to our science. Those of us fortunate to have known him, be it ever so slightly, will always recall with deep affection the figure and charm of his princely person, his personality, his strong character, his help, and his skill, and above all, his polite and courteous attention to our own individual problems that we brought or sent to him, never in vain and never without profit to our patients and to ourselves.

But the debt that I owe him is still more personal. Out of the pages of his writings, his wisdom has guided me and has solved many problems for me during these war years of great responsibilities in an unfamiliar assignment. I should like to take this opportunity to speak for a few moments of the medical officer, Brigadier General George E. de Schweinitz, Chief Consultant in Ophthalmology to the Surgeon General during the first World War. His writings and reports on ophthalmology contained in the History of the Medical Department in the World War, published by the War Department in 1924, were the first things I sought out on entering the Army and were ever at hand for reference.

On October 11, 1917, the then Lieutenant Colonel G. E. de Schweinitz, M.R.C., received confidential orders No. 92, W.D. par. 10, requesting him to proceed overseas on an inspection trip to study the problems of ophthalmology in the Medical Corps and to report his findings and recommendations to the Surgeon General. In the company of several other officers in the Office of the Surgeon General, he left on October 29, 1917, and returned on March 1, 1918. Col. Allan Greenwood, M.R.C.,[4] the Senior Consultant in Ophthalmology to the Chief

* The de Schweinitz Lecture. Delivered before the Section on Ophthalmology of the College of Physicians, Philadelphia, November 15, 1945. From the Department of Ophthalmology, Northwestern University Medical School.

Surgeon, A. E. F., in his "History of ophthalmology in the A. E. F.," published in the same volume, pays this tribute: "Before the arrival of a large number of American troops in France a most helpful and important stimulation toward an improvement in the ophthalmic service in the A. E. F. came about through the observation visit to France and England of several officers from the Office of the Surgeon General. The encouragement given to the young men and the recommendations to the Chief Surgeon and the Surgeon General as a result of this visit were the real start of the Ophthalmic Service of the A. E. F." I can add with truthfulness "and were the real start of the Ophthalmic Service of the E. T. O.," as I hope to show you.

Lieutenant Colonel de Schweinitz, before seeing the American units, visited and observed the British Eye Service in France, both at the front and at the base. He was impressed with the efficiency with which the eye patients were handled, particularly with the speed with which prescriptions for spectacles were filled, often within 15 minutes, even in the front lines. He studied the British methods and equipment, found much to praise, and detected some flaws there which he endeavored to correct in our own Service. His recommendations, although not entirely carried out, resulted in an Ophthalmic Service in the A. E. F. that was second to none. Had his original recommendations been followed to the letter at the time of our preparation for war in 1940 or even as late as 1941, much of our troubles and many of the problems that we later encountered in the E. T. O. and other theaters would have been avoided. But I think that the War Department suffers a chronic form of Korsakoff's syndrome, particularly a loss of memory for the lessons of recent wars. In this instance, at any rate, it forgot the ophthalmic experiences of the last war and muddled into the same errors, fortunately not entirely too late for correction in the E. T. O.; very late, however, for the M. T. O., and almost too late for the Pacific Theater.

Colonel de Schweinitz recommended that one ophthalmic surgeon be stationed in each evacuation hospital. In this war it was not done until the lessons of the African Campaign had been bitterly learned. By the time the Table of Organization of an Evacuation Hospital, which is a front-line establishment, had been officially changed to include an ophthalmic medical officer, there was a grave shortage of officers. It was another example of "too little and too late." One had to be content with what could be scraped up, and the ophthalmic care of the wounded soldier in the Army areas was, perhaps, not so good as it might have been. There was no provision for the placement of an enlisted man trained as a practical optician in an evacuation hospital. Our officers searched their detachments and generally came up with an optometrist or optician whom they wangled into helping them in the eye clinic.

Colonel de Schweinitz recommended, too, that optical shops be established not only in the base of the eye centers but also in the forward areas. These optical shops were to be equipped with round frames and stocked with preground round lenses that only required edging for speedy insertion. Our system of issuing oval lenses and fancy frames, together with round gas-mask insert lenses —in other words, two types of lenses— was a clumsy one and led to many difficulties. After several years of bitter frustration the situation was eased, but never became entirely satisfactory in any theater of operation. The development of auxiliary or portable optical repair units was slow and late. But I must say that

those that arrived were well used. This is a lesson we could have learned early from Dr. de Schweinitz's report.

Among his recommendations was one advising the encouragement of ophthalmic research. It was fruitful in the last war. It has influenced the policy along this line in this one, and the results of this encouragement are now apparent in our journals.

His most important recommendation was that of placing a chief consultant in Ophthalmology in the Chief Surgeon's Office. It is a matter of history now how valuable this was in the last war, and it is written for all to see. It could have been read in 1940. In this war, no authorization for such a position was ever made. In the E. T. O. the consultants in the medical and surgical specialties were appointed at the specific request of General Paul Hawley, the Chief Surgeon, and charged against the allotment of officers on his staff. No other theater of operations had these consultants. In the Mediterranean Theater the Chief Surgeon was compelled by circumstance to utilize the services of Major Trygve Gundersen (MC), in this capacity and on an informal basis. Without the recognition that should go with the importance of the post or the grade the position required, Major Gundersen did a splendid job and cleaned up a mess for which he has received little credit and no promotion. No consultant in ophthalmology was appointed in the Pacific Area until a few weeks before V-J Day, when Lt. Col. James Greear (MC) was chosen. He was about to sail when victory was won. There were many ophthalmic problems in that theater crying for solution up to the very end. Nor was it until the spring of 1944 that a Chief Consultant in Ophthalmology, Major Elliott Randolph (MC), was appointed to the Office of the Surgeon General. From the beginning of the prewar preparations in 1940 until then, ophthalmic policies and plans were kicked around more or less haphazardly in the Office of the Surgeon General and referred to medical officers who were not ophthalmologists nor in some cases particularly interested. Major (now Lt. Col.) Randolph's appointment was a great success and he handled very efficiently the ophthalmic problems that came up.

Colonel de Schweinitz reported on the lack of equipment, particularly perimeters. The Supply Division of the Army Medical Department is allergic to perimeters and the lack of equipment is a perennial cause of complaint. Very few perimeters or slitlamps were provided the overseas units in this war either.

The results of Dr. de Schweinitz's report became apparent in early 1918. A Chief Consultant (Colonel Greenwood) was appointed to the staff of the Chief Surgeon, A. E. F., the equipment improved, base optical shops and auxiliary optical shops were developed, and eye centers established which functioned well and capably.

The reading and studying of this report was of inestimable value to me in my capacity as Senior Consultant in Ophthalmology in the E. T. O. The hints, clues, and specific recommendations guided me at a time when no other source of help was available. The ophthalmic services in the E. T. O. were improved accordingly. So you can see why my personal gratitude to the guiding hand of George E. de Schweinitz, as revealed in the pages of a book, is most profound.

His chapter on "Ophthalmology in the United States" in the same volume is a masterpiece of assembling and presentation. Those of you who have read it will recall the eloquence of the writing, the same policies of treatment, the orderly arrangement of text and illustration, and

the valuable and lively descriptions of specific cases of war injuries. Increase the number of cases and alter the statistics upward, and the chapter would give us the ophthalmic lessons of this war. The historical and prophetic sense exhibited here is another side of Dr. de Schweinitz's genius that should, some day, be further explored to the great benefit of our profession.

Therefore, if I have succeeded in this exposition in picturing to you and calling to mind but a small part of the enormous contribution that Dr. de Schweinitz has made in the field of war ophthalmology alone, my debt to his memory will have been partially discharged.

I have been much tempted to devote this lecture to a review and discussion of the work done by Dr. de Schweinitz in the last war and continue the parallel description of ophthalmic matters and policies in this one. I am quite sure that the honors would remain with Dr. de Schweinitz and his group in spite of the fact that this war was a much greater venture. I am also quite certain that the ophthalmic care of the sick and wounded was better in this war than in the last, but only because of the better professional training of the ophthalmic medical officers as a group compared with the ones in the last war, and in spite of more or less muddled planning.

However, I think that we are all fed up for the time being with war topics and discussions of military matters and war medicine. Perhaps later on our appetite for these subjects will return. I, for one, would, therefore, prefer to discuss a small subject in the field of ophthalmic surgery. It is one, I think, that would have interested Dr. de Schweinitz were he here today, for one of the facets of his many-sided character was his keenness for and skill in all aspects of surgery pertaining to the eye.

History of scleral resection

Scleral resection was introduced in 1903 by Leopold Müller[10] of Vienna and was originally designed for retinal detachment in patients with myopia, usually of high grade. Müller considered that the cause of the retinal detachment in these cases lay in a stretching of the sclera at the expense of the retina. It logically followed, therefore, that he should try to shorten the globe and thus bring the sclera to the retina. It is not clear from reading his description just how he expected the retina to stay in place, for nowhere do we find him discussing adhesive choroiditis.

He selected for operation those cases of detachment that had persisted for a year or more without improvement. In his early cases he performed the Krönlein operation in order to expose the temporal aspect of the eyeball, choosing this area arbitrarily because of its relatively easy access. In answer to a question raised in a discussion of the operation as to why he chose the temporal part of the eyeball and not the area of the greatest detachment, Müller said that he performed the operation only when the entire retina was detached. He later abandoned the Krönlein operation, replacing this step by an external canthotomy.

His first patient was operated upon in 1903. The case was that of a man with myopia of 9 diopters in his only useful eye. Retinal detachment occurred and was treated medically for some time, without success. After doing a Krönlein operation and a tenotomy of the superior, external, and inferior recti muscles and exposing the operative field of the eyeball, Müller resected an oval piece of sclera 8 to 10 mm. in width and 18 to 20 mm. long from the temporal side of the eyeball. The patient was operated on under general anesthesia; subsequent authors referred to

it as lengthy and formidable. The anterior border of the resected area was 1 to 2 mm. behind the insertions of the muscles, and the posterior border was in the neighborhood of the equator. The postoperative recovery was uneventful, and the case was considered a success in that the vision was restored to ability to count fingers at 3 meters, the retina was back in place, and the periphery of the field of vision was full. The poor vision was due to a central scotoma as the result of old chorioretinitis.

Three other cases were mentioned by Müller at this time, but the details were not given. Although the exact technique that Müller followed is not described in his original presentation, one can gather a very good idea from a study of subsequent papers by various authors, especially one by Lenz.[7] Silk sutures were placed prior to excision and tied as the operation proceeded. Müller writes of the care that is needed to avoid injuring or rupturing the choroid as it is exposed, and of the danger of serious hemorrhage and loss of vitreous. With a fine knife, he punctured the choroid as it lay exposed, thus releasing subretinal fluid and permitting the choroid to be tucked in as the sutures were tied.

In 1913, Müller[11] reported two cases of retinal detachment cured by scleral excision and mentioned that he had done the operation on 19 patients.

Between 1903 and 30 years later, when Lindner[8] revived interest in the operation, there appeared sporadic case reports and articles in the literature, all of which were European. The interesting thing to me in the study of these reports is the paucity of details regarding the operative technique itself or the results, which on the whole were not good. Dr. Leopold[12] of Philadelphia, in discussing a recent paper by Pischel, remarked that he had collected 121 cases of scleral resection from the literature, in 25 of which there was successful reattachment and in 31 of which partial or temporary reattachment; the rest presumably were failures. This represents cures of about 20 percent, which, considering the types of cases in which the operation is usually performed, is, to my mind, brilliant.

As is well known, Lindner in 1933 modified Müller's technique. He reported operating 23 times on 12 eyes which, with few exceptions, were associated with myopia. He thought that the best results were to be obtained in those cases in which he removed a piece of sclera from the entire circumference of the eyeball in two operations, or in those cases wherein the detachment of the retina occurred in aphakic eyes.

The technique described by Lindner was used for the first time in this country by D. K. Pischel.[13] He and Miller reported the successful case in detail and gave a full analysis of the technique which I should like to quote here.

> The sclera is laid bare, and one rectus muscle is cut off. Specially equipped dividers are needed, one leg of which has a dull point and the other a sharp blade. A line concentric with the limbus and 9 to 10 mm. from it is lightly cut in the sclera by drawing the dividers over it, the blunt end being kept on the limbus and the blade end in the sclera. Next, a second line is cut posterior to the first one, in a similar manner, the blunt end of the compass being kept on the first cut and a new cut being made with the blade end. These two incisions should be from 2 to 6 mm. apart.
>
> The incisions are deepened with a keratome through three quarters of the scleral thickness. Care must be taken not to perforate the sclera and choroid, as the eyeball may collapse or a severe hemorrhage may occur. Double armed fine chromic catgut sutures are placed 2 mm. apart through both peripheral lips of the incisions (in the form of a mattress suture), leaving the flap free. These sutures should be placed at this time for it is difficult, if not impossible, to do so after the piece of sclera has been entirely excised. After the sutures are in place, the crescent of sclera is slowly cut out. First, the two parallel incisions are joined at one end, and then with a fine scissors the remaining layers of scleral fibers at this end are cut through

leaving the choroid bare. Care must be exercised to see that the choroid is free from the sclera. When 2 to 3 mm. have been cut through, the first set of sutures is carefully tied, care being taken that the choroid is not caught in the lips of the sclera as the sutures are drawn up. The free end of the flap of sclera is drawn under the other sutures and the flap is cut through farther along, the sutures again being tied as more choroid is laid bare. As the process continues and the globe becomes smaller, the choroid will be bulged out through the incision by the pressure from within. The choroid must be punctured with a fine discission needle and some of the intraocular fluid be allowed to escape. [Borley[1] in one of his papers mentions the value of repeated paracentesis during the operation at this stage in order to prevent too rapid and too much herniation of the choroid.] The choroid can then be tucked back inside the sclera. In making the puncture one should avoid large choroidal vessels, as otherwise disturbing hemorrhage may occur. After the crescent of sclera has been completely excised and the last scleral suture tied, the cut muscle may be resutured, and the conjunctival incision closed. In cases in which former operations had been performed, the choroid will be found adherent to the sclera. Here a thin layer of scleral tissue may be left behind.

In his most recent paper, Pischel[12] enlarges on the technique and mentions that it is advisable to touch the choroid, at least where punctures are to be made, with a 3-percent potassium-hydroxide solution, and wash off any excess. He goes on further to say:

Experience has shown several points worthy of emphasis. When operating too soon after previous surgery, the sclera will be found to be boggy. Sutures pull out easily and an unexpected scleral perforation can occur. In reoperated areas, adhesions of Tenon's capsule to the sclera are very troublesome, and cause considerable bleeding which must be controlled. Here, also, care must be taken not to cut into the sclera when dissecting blindly. Vortex veins may interfere with the desired placement of the lines of incision and necessitate varying the symmetry of these. Sometimes a thin layer of scleral tissue in which vortex veins are imbedded can be left and folded inward, as in choroido-scleral scars. Cutting such a vein exteriorly causes hemorrhage difficult to control, but cutting it internally may cause devastating intraocular hemorrhage.

He discusses the difficulties and dangers of the operation and continues on to give valuable hints on how to avoid them. This article is most noteworthy, for it not only presents the technique of the operation and case reports by an author of experience, but the description is followed by a most enlightening discussion. It should be read in its entirety by all who are interested in the subject.

Recent and personal case reports

Scleral resection has been employed successfully in (a) cases of retinal detachment, (b) cases of high myopia, and (c) cases of scleral staphyloma with and without retinal detachment.

Retinal detachment. The recent literature, since Lindner's article appeared in 1933, is not rich in case reports and studies, although it is entirely possible that the operation has been performed more often than reported. For example, in 1940 I performed a scleral resection on a woman whose only eye was aphakic and on whom two previous diathermy operations had been done without success. The retina was reattached, and the corrected vision restored to 20/70. In 1941, as a last resort, the operation of scleral resection was done three times on the only eye of a young man who had a complete detachment but no real improvement followed, although the eye stood the operations surprisingly well. These cases were not reported at the time because it was desired to accumulate more cases and experience before presenting the material. This is very likely the experience of other surgeons.* Pischel[12]

* Since the preparation of this paper it was learned that Dr. D. W. Bogart of New York presented a paper before the New York Society for Clinical Ophthalmology, on October 1, 1945, discussing the surgery and his results on 18 cases of scleral resection for retinal detachment. He very kindly sent me notes of his paper, which has not yet been published. His operation

and Borley[2] have each reported their results in a small series of cases, and the record, on the whole, is good when one considers the desperate nature of the cases chosen. For example, there is the brilliant result obtained by Pischel in his second case, which I should like to cite in full detail. It emphasizes the premise that one should not give up in retinal surgery until all is hopelessly lost. Pischel's dogged determination and the patient's fortitude brought about an astounding cure.

> A young man, aged 30, had had congenital cataracts needled innumerable times. The right eye was finally lost. A last operation on the left eye, apparently pulling out a dense membrane, gave him about 10/200 vision with ability to read typewritten copy with a magnifier. In July, 1940, he was sent to me (Pischel) because of a retinal detachment in the nasal superior quadrant. Briefly, examination showed an aphakic eye, eccentric pupil, moderate oscillatory nystagmus, and a detachment of the retina in the nasal superior quadrant. It was necessary to give avertin anesthesia to stop the nystagmus so that a reasonably complete fundus examination could be made. A small doubtful tear was seen toward 10 o'clock.
>
> The first operation was a Lindner undermining, with the result that the detachment spread to the whole nasal half. The second operation was a diathermy coagulation of the original region. This resulted in spread of the detachment to include the entire lower half as well. The third operation, undertaken too soon, resulted in an unexpected perforation through the boggy sclera, with a gush of watery brown fluid, allowing the eye to collapse. The fourth operation, undertaken two months later, was an eyeball shortening of the whole lower half of the globe, a 3 mm. wide crescent being cut out. At the same time the site of the tear was again treated with diathermy coagulation. Convalescence was uneventful. Ten days post-operatively the patient stated that he saw better. Two weeks later a fundus examination showed the retina everywhere to be less elevated. Conditions improved and the patient finally recovered 6/200 vision with the retina everywhere in place. The visual field was normal. This condition prevails . . . over four years later.

I believe that there is not enough statistical data in the literature as yet to give us more help than we already have. The cases prior to 1930 ought to be discarded in such a study, because the modern knowledge of the surgical treatment of retinal detachment began at about that time. Lindner's paper (1933) focused our attention on the main principles of scleral resection, and the relatively few cases reported by him, Pischel, Borley, and others since that date are suggestive and promising only. One cannot praise these pioneers too highly. I wish, therefore, to emphasize the point that scleral resection is an operation that is feasible and offers some hope of success, even in extreme instances. There are many problems that still need to be ironed out. For example, we need to know more about what happens to an eye after scleral resection. Animal experiments offer a fertile field for study here. Technical details will improve and new instruments will be devised that will help shorten what is now an arduous and long operation.

HIGH (MALIGNANT) MYOPIA. A paper by W. E. Borley and O. R. Tanner[1] in a recent issue of the American Journal of Ophthalmology had for its title "The use of scleral resection in high myopia." This, so far as I know, is the first time

---

consisted, briefly, of the excision of a piece of sclera 5 by 12 or 14 mm. near the equator in the area of the detachment. A specially designed caliper was utilized to mark off the area. The incision down to the choroid was made with a specially designed knife. Following the closing of the wound, the surface over the area operated upon was "coagulated" by using a suitable spatula heated in an alcohol lamp. Eighteen eyes were operated upon; 39 percent were cured; 39 percent showed 80-percent cure; 15 percent showed from 25- to 40-percent cure; and one out of 18 was a failure. In other words, 78 percent of these 18 eyes showed from 80- to 100-percent cure. Ten of the 18 eyes were aphakic. It is to be noted that all 18 eyes were considered inoperable by the usual methods. Ten of them had had previous operations, and three had had as many as three operations.

that such a title has appeared in the literature. The authors mention that Müller, Elschnig, Lindner, and Pischel have reported cases. Hildesheimer[5] also reported attempts made by Arlt, Wolfe, Perinaud, and Galezowski to relieve high myopia and to improve or to prevent retinal detachments in myopic eyes by scleral resection. Holth[6] did what he called "Trepanato sclerae prae-aequatorialis" in two cases of high myopia in which no retinal detachment existed, claiming good results although he mentioned few details and gave no report on vision. In four cases (two with retinal detachment) of high myopia, the myopia decreased from 12.0 to 5.50 diopters, 17.0 to 6.0 diopters, 16.0 to 10.0 diopters, and 18.0 to 5.50 diopters. His operation consisted, briefly, of using a 2.5-mm. Bowman trephine to bore a hole in the sclera to the choroid, about 12 mm. from the limbus between the external and inferior recti muscles. He then used his 2-mm. scleral punch, after first passing a spatula between sclera and choroid, backward in a meridional direction, and removed a piece of sclera 1.8 by 1.5 mm.

In 1937, Hildesheimer, using an electrocautery in the form of a loop, excised a piece of sclera for the reduction of myopia in two cases of unilateral high myopia, with good result and with a reduction in myopia in the first case from 31.0 to 20.0 diopters, and in the second from 15.0 to 13 diopters.

Borley and Tanner's case was that of a woman of 56 years. Prior to operation her refraction was: Right vision with -17.75D. sph. $\bigcirc\!\!\!=$ -1.0D. cyl. ax. 80° was 15/200; left vision with -18.75D. sph. sufficed for the perception of hand movements at two feet. The eyeballs were protruberant, and there were extensive choroidal changes and vitreous opacities, especially in the left eye. In January, 1941, the left eye was operated upon and a strip of sclera 2 mm. wide, 11 mm. from the limbus from the 12- to the 6-o'clock position, was excised. The technique used was that previously described, with the addition of repeated paracenteses at about 5-minute intervals to allow the intraocular pressure to remain low. The postoperative course was uneventful. The same operation was performed on the right eye in June, 1941. There was slight but definite improvement up to January, 1943. In September, 1944, the corrected vision was: R.E., 15/70; L.E., finger counting at two feet. There was no change in the refraction, which is difficult to explain, and no change in the ocular fundi except for the heavily pigmented scar of the operation far temporally.

Pischel (1945) reported the case of a man, aged 55 years, with myopia of 17 diopters, whose vision in the right eye was 20/50; left eye, finger counting at three feet. A scleral resection was done on the left eye as a "training" move. Later, the same operation was performed on the good eye, a 3-mm. crescent of sclera being excised from the temporal half. The anterior chamber was repeatedly drained during the operations. Convalescence was uneventful. The author states that the distance vision changed little but the near vision improved. The change, if any, in the refractive error was not mentioned.

It is disappointing that here, too, more details are not given in these case reports. However, we do learn from them that the operation is possible and not particularly dangerous. Further studies will be stimulated. I believe that the operation does have a future in selected cases and it appears, on the surface at any rate, to be less hazardous to the eye than is the removal of a clear lens in these cases of high myopia.

SCLERAL STAPHYLOMA. *1. The anterior (intercalary) scleral staphyloma.* In 1943 Gayer Morgan[14] showed a patient before

the Ophthalmological Society of the United Kingdom upon whom he had successfully performed an excision of a ciliary staphyloma. The case was that of a young boy who had developed a ciliary staphyloma of the right eye, five years after glaucoma secondary to a needling operation for congenital cataract had developed. The conjunctiva was dissected off the posterior half of the staphyloma, conjunctival stutures were inserted and left loose. Mattress sutures were passed right through the staphyloma from the limbus to the healthy sclerotic behind the staphyloma by means of a large cuting surgical needle. It had been planned to evacuate a little fluid from the staphyloma, but enough escaped through the holes made by the needle, and the eye became reasonably soft. The sutures were then tied, and the staphyloma was snipped off. The preoperative astigmatism of 6 diopters was reduced to about 1 diopter. One attack of glaucoma had subsequently occurred, but the intraocular pressure was controlled by eserine. This successful case is a most impressive one, and the technique described is simple. The operation should be performed in all such cases which otherwise are hopeless and end in enucleation or perforation.

Although not quite in the same category, the case described by Spaeth[15] might be mentioned here. A limbal staphyloma or ectasia followed a blow with a screw driver. The conjunctiva above the staphyloma was incised in a crescentic manner and mobilized for a large subsequent flap. The staphyloma was then opened with sharp scissors, and the iris prolapse was cleanly removed with de Wecker scissors. Two 6-0 waxed black-silk sutures were inserted in the edge of the corneal lip and passed into the bared scleral lip of the original corneoscleral incision, tied, and cut short. The conjunctival flap was then brought over and sutured slightly past the midline of the cornea.

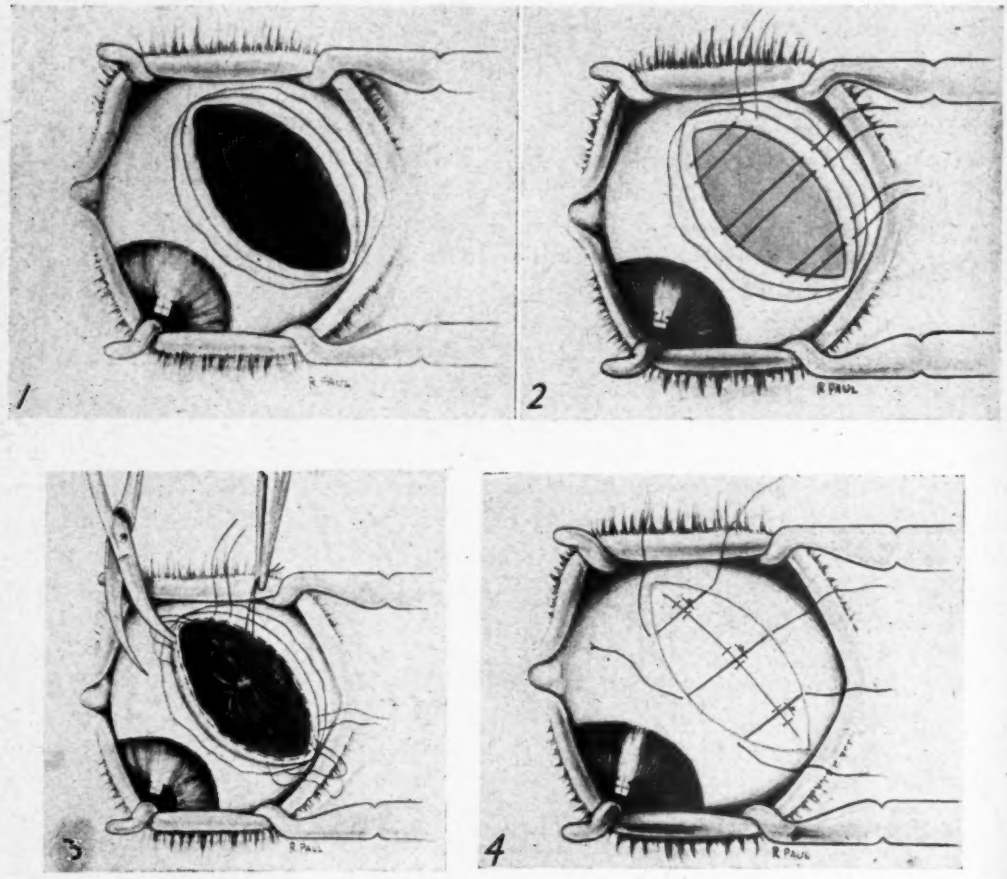
2. Equatorial scleral staphyloma. Before the American Ophthalmological Society in 1940, I reported[16] a case of equatorial scleral staphyloma and retinal detachment cured by excision. The patient was a white woman, 57 years of age, who, on June 16, 1936, noticed a blur in the vision of the left eye which rapidly became worse. The right eye was normal. The examination showed a balloon detachment of the retina in the upper temporal area. When the overlying sclera was exposed in preparation for a diathermy operation, a large equatorial scleral staphyloma was unexpectedly encountered (fig. 1). It measured, roughly, 12 by 15 mm. and began abruptly at a point 6 or 7 mm. from the limbus. It occupied the area between the tendons of the superior and external recti muscles and, therefore, was obviously over the retinal balloon. Because of this situation, it was decided to excise the staphyloma in a method similar to the eyeball-shortening operation described by Lindner. In view of the subsequent events, I should like to describe the operation which was performed on June 29, 1936, in the exact words used in the case report. Two double-armed sutures were inserted along the edges of the staphyloma (fig. 2) and looped out of the way. A fixation suture was placed in the center of the ectasia. A Graefe-knife incision was made along the upper and inferior edges, and excision was completed with curved scissors (fig. 3). The fixation suture was of incalculable value at this point, for traction on it gave excellent control of the eyeball and of the portion being excised and, at the same time, created a negative pressure which prevented vitreous from spilling. Subretinal fluid and presumably fluid vitreous were lost, but, on completion of the excision, which included part of the retina, the main vitreous body could be

seen glistening clearly like water deep in a well. The sutures were quickly tied and a third was placed between them (fig. 4), thus bringing the edges of the wound tightly together and forming a small linear ridge of sclera.

The eye healed kindly, the retina was reattached, and, when the patient was examined three years later in preparation for the report of the case, the vision with correction was 20/40+ and J2 (fig. 5). The line of vision was "tented," owing to a slight disturbance in the macula. The refraction had changed from −1.0D. sph. ⌯ +1.75D. cyl. ax. 115°, prior to the detachment, to +1.75D. sph. ⌯ +5.25D. cyl. ax. 25°, three years after operation.

The patient's son-in-law, who is a well-trained and keen ophthalmologist now in the Army, kept me informed from time to time regarding the condition of her eye, which remained good.

On April 28, 1945, she appeared at the Army hospital in which her son-in-law was stationed, complaining of a blur in the vision of the right eye. The following notes were made from his examination.



Figs. 1-4 (Vail). The scleral-resection operation. Fig. 1, Diagrammatic appearance and position of the staphyloma. Fig. 2, Showing the value of the fixation suture. Fig. 3, Diagrammatic drawing of position of sutures. Fig. 4, Showing closure of the wounds.

"The right eye has been observed at approximately yearly intervals since 1936, and since 1939 there has apparently been a very slow stretching of the sclera in the temporal area, as evidenced by some chorioretinal pigmentation in the temporal portion of the fundus. This was very slight until June, 1944, when a considerable amount of chorioretinal scarring was observed. The fundus temporally was seen with a minus 13.00 sphere lens, while the macular area was seen with a minus 1.00 sphere lens. It was felt that the stretching of the congenitally thin sclera in the left eye had been rather rapid prior to the detachment of the retina in the left eye in 1936. The sclera in the right eye had probably been stretching very slowly, giving the chorioretinal adhesions an opportunity to form and hold the retina in place. In the first week in April, 1945, the patient bumped the top of her head on a cabinet door. Visual symptoms began about the 17th or 18th of April as a small defect in the upper nasal field of the right eye. It became more noticeable, and in a few days she found that she was unable to read with the right eye. The examination on April 28th showed a large bullous detachment in the lower temporal quadrant; the vision was reduced to counting fingers at 2 feet.

External Examination. Right eye. Between the 8- and 10-o'clock positions, about 12 to 15 mm. from the limbus, the sclera was very thin and ectatic. This was greatest between the 9- and 11-o'clock positions. It extended back as far as one could see. The cornea was clear, the anterior chamber of normal depth, the iris pattern normal, and the pupil was round and reacted.

Left eye. Between the 2- and 4-o'clock positions, about 10 mm. from the limbus, there was a healed scar in the conjunctiva and sclera, the site of the operation. At the lower end of this scar there was a small, ectatic, slightly bluish area due to the distortion of the scleral coat. This was essentially the same as it was in 1936.

Ophthalmoscopic Examination. Right eye. The nervehead was normal. The retina between the 12- and 5-o'clock positions was in place, and no particular degenerative change was noted. From the

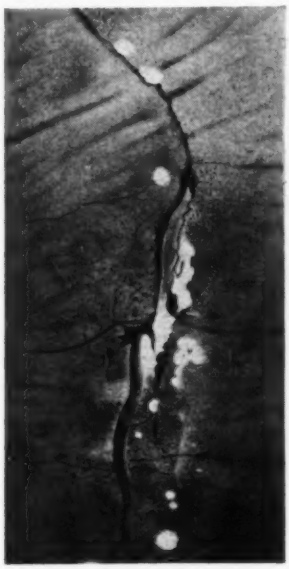


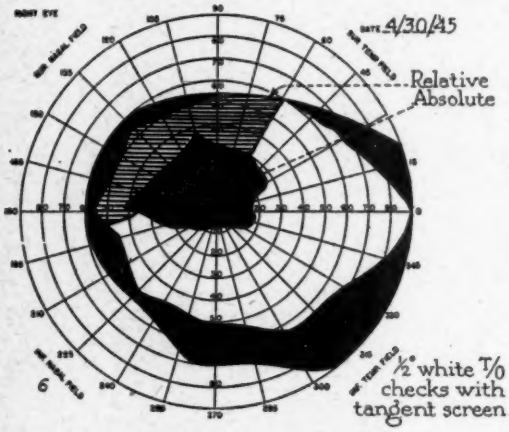
Fig. 5 (Vail). Fundus appearance three years after operation; left eye.

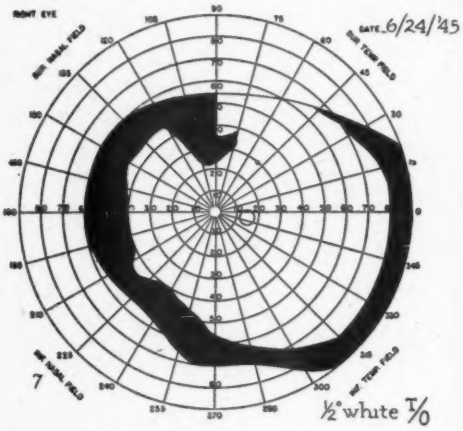
5- to the 10-o'clock position there was a detachment of the retina extending from the equator to the periphery. From the 5- to 6-o'clock positions, from the equator to the periphery, there was a slightly wrinkled, low detachment which joined a large bullous detachment. Above the upper temporal border of the bulla there was a flat detachment which extended to about the 11-o'clock position. At the 9:30-o'clock position, between the equator and the ora, there was a small area of blood in the retina. No definite hole or tear could be made out. Toward the periphery the elevation of the retina was less marked than at the equator. The macular

area was obscured by the bullous detachment (fig. 6).

Left eye. There were a few stringy vitreous opacities centrally located. The nervehead and blood vessels were normal. A slight irregularity of the surface of the retina was observed in the macular area. The retina everywhere was in place. There was a large scar in the equatorial region extending from the 2- to the 4-

Under local anesthesia (retrobulbar and Van Lint injections of novocaine) and superior rectus bridle suture, the conjunctiva and Tenon's capsule were incised over the area of the scleral staphyloma, which was discovered to be larger than suspected, measuring approximately 20 by 7 mm. and rising abruptly from the surface of the sclera. It was bluish in color and very thin, dimpling at the





Figs. 6, 7 (Vail). Field studies. Fig. 6, Preoperative field of vision; right eye. Fig. 7, Postoperative (6 weeks) field of vision; right eye.

o'clock position. The retinal vessels could be seen to stop abruptly at the chorioretinal scarring. Peripheral to the operative site there was considerable chorioretinal scarring, and the retinal vessels could not be seen. There was no other fundus lesion.

The patient was kept in bed, wearing pinhole glasses and using atropine in the right eye. On May 8, 1945 (V-E Day), operation on the right eye was performed (scleral resection) by me, assisted by Lt. Col. Elliott Randolph (MC.), and Capt. John McGavic (M.C.). I am greatly indebted to them for the opportunity and their skillful help during the operation, and for the careful notes and postoperative care of the patient by one of them (J. McG.).

slightest pressure. The external rectus was reflected. Three 7-0, black-silk sutures on atraumatic needles were firmly placed in the sclera on each side of the ectasia, in which a fixation suture had been placed. A part of the ectasia was then excised in the same way as described in the operation on the left eye, and the three silk sutures were tied. This left a buckled area in the sclera at the lower end of the incision. It was felt that reattachment of the retina was quite unlikely to take place if this folding of the remaining scleral ectasia was allowed to remain. Sutures were then placed in the sclera on each side of the fold, and the rest of the staphyloma resected. When the sutures were tied, the contour of the globe was quite good, and no buckling or fold-

ing remained. During the short time that the scleral wound was open, the vitreous appeared to be of good consistency. Surprisingly little vitreous was lost. The conjunctiva and Tenon's capsule were closed with interrupted black-silk sutures. A good reflex was present after the operation. Atropine and sulfathiazole ointment were applied, and a binocular Ring mask used.

The piece of excised sclera was thin and rather "brittle." Some blood and pigment were present on its inner surface, but no retinal elements were to be seen on microscopic examination of the tissue later.

Convalescence was uneventful. In 12 days the postoperative reaction, which was not great, had almost completely subsided. There was a good fundus reflex throughout. Some blood in the lower portion of the vitreous was seen, as well as choroidal and retinal hemorrhages at the lower end of the incision. The retina appeared to be in place. The field of vision was full (fingers). On the 24th of May, pigmentation along the lips of the scleral-incision area within the eye could be seen. The patient was discharged from the hospital on June 10 (fig. 7). On July 8, 1945, two months after the operation, the examination showed the retina to be in place everywhere. A small vitreous hemorrhage was still present. The retinal and choroidal hemorrhage had become absorbed, and pigmentation along the scar was well advanced (fig. 8, see Frontispiece).

The refraction in the right eye was found to have changed from −0.50D. sph. ⌯ −0.75D. cyl. ax. 175° with which the patient had 20/20+ vision prior to the onset of the detachment, to +1.25D. sph. ⌯ +4.50D. cyl. ax. 175°, which gave her a vision of 20/30+1. With +2.50D. sph. added she read J1. The vision of the left eye on this date, with +3.50D. sph. ⌯ +3.25D. cyl. ax. 25° was 20/40−1; with a +2.50D. sph. added she read J1 slowly.

This extraordinary case of double, scleral equatorial staphyloma and detached retina cured by scleral resection of the staphyloma gives us much food for thought. The origins of these lesions are mysterious, and they are usually monocular when they do occur. The underlying weakness of the sclera may very likely persist for a long time before the sclera more or less rapidly yields. The absence of all signs of glaucoma in this case rules out increased intraocular pressure as the exciting cause. It is logical to assume that some inherent weakness of the scleral coat existed, probably on a congenital basis, perhaps similar in its genesis to that encountered in keratoconus, affecting the temporal equatorial region of both eyes. The possibility that a cyst of the retina may be the cause of the scleral ectasia as the result of pressure is another thought. If this were so, it would explain the absence of retinal elements on the underlying surface of the excised specimen. Nor is there any answer to the question: Why was vitreous lost at all if the retina was intact? The more or less linear scar seen with the ophthalmoscope, particularly in the left eye, suggests a linear cut or tear in the retina at the time of operation. Other questions that need an answer are: Why was the temporal area affected in each eye? Is this the influence of the action of the superior oblique or other ocular muscles upon a weakened sclera? Nine years have elapsed since the first operation was performed and, as yet, no recurrence of the staphyloma has developed in spite of the continued normal action of the superior oblique and other ocular muscles. The temporal radial meridian of the eyeball is greater than the nasal in relation to the support given to the eyeball by

the optic nerve and the limbal area, and this may also be a factor. But further speculation is fruitless until we know more about the condition. However, I believe it would be a wise policy to excise these staphylomas before retinal detachment occurs in view of the fact that the technique of scleral resection lends itself very well to this condition.

OTHER CONDITIONS in which scleral resection could be considered (speculative only): 1. The removal of a melanoma of the choroid in an only eye. 2. An area of severe episcleritis, or inflammatory nodule, or malignant lesion in the sclera. 3. The excision of disintegrating areas or plaques in the sclera in scleromalacia perforans.

EXPERIMENTAL STUDIES

So far as could be determined the only laboratory experimental studies of scleral resection reported in the literature are contained in a paper by Wiener.[17] He, however, was primarily interested in resecting strips of sclera longitudinally, thus lengthening the eyeball. He found that if one excises an elliptical segment of sclera 9 mm. long and 1.5 mm. wide from four opposite sides of the eye and brings the edges together by means of three sutures each, the eye will be lengthened approximately 2.5 mm. to 3.0 mm. The refraction is changed from about normal to between 8 and 9 diopters minus. Wiener found that in lengthening the eye, the increase is 1.27 times the width of one of the segments removed. In shortening the eye, the decrease is 0.636 times the width of the segment removed, or about half as much as in the lengthening process.

SUMMARY AND CONCLUSIONS

The technique of scleral excision is described. It has been successfully performed by a number of ophthalmic surgeons in cases of retinal detachment, high myopia, and anterior and posterior scleral staphylomas. Enough operations on each of these conditions have been performed to indicate its value in selected instances. It is worthy of further study, particularly with a view to improvement in its technique and the development of special instruments to increase the facility of its function. There is a need, too, for experimental studies, particularly in laboratory animals. The question of scleral staphyloma needs further elucidation.

I am indebted to Lee Allen, artist, Department of Ophthalmology, University of Iowa Medical School, for the beautiful fundus painting.

55 East Washington Street (2)

REFERENCES

[1] Borley, W. E., and Tanner, O. R. The use of scleral resection in high myopia. Amer. Jour. Ophth., 1945, v. 28, p. 517.
[2] Borley, W. E. Shortening of eyeball for retinal detachment. Arch. of Ophth., 1940, v. 23, p. 1181.
[3] Elschnig, A. Ueber die operative Behandlung der Netzhautablösung. Arch. f. Augenh., 1914, v. 77, p. 252.
[4] Greenwood, A. Ophthalmology in the A. E. F., Med. Dept., U.S.A., in the World War. Washington, Govt. Print. Off., 1924, v. 11, pt. 2, Surgery, p. 650.
[5] Hildesheimer, S. Essai de diminution de la myopie par excision de la sclérotique par la loupe electrique. Trans. Int. Ophth. Congress. Commun., 1937, v. 4, p. 320.
[6] Holth, S. Neue Operationbehandlung der Netzhautablösung und der hochgradigen Myopia (Trepanato sclerae prae-equatorialis). Ber. über d. Versamml. d. ophth. Gesellsch., 1911, v. 37, p. 293.
[7] Lenz, G. Die aequatorielle Skleralresektion nach Leopold Müller. In Graefe-Saemisch's "Handbuch der gesamten Augenheilkunde," 1922, v. 2, p. 1320.

[9] Lindner, K. Heilungsversuche bei prognostisch ungünstigen Fällen von Netzhautabebungen. Zeit. f. Augenh., 1933, v. 81, p. 277.
[9] McAlester, A. W., and Borley, W. E. A double-bladed knife for scleral incisions in shortening of the globe. Amer. Jour. Ophth., 1944, v. 27, p. 641.
[10] Müller, L. Eine neue operative Behandlung der Netzhautabhebung. Klin. M. f. Augenh., 1903, v. 41, p. 459.
[11] ———. Operative treatment of detachment of the retina. Ophth. Rev., 1913, v. 32, p. 324.
[12] Pischel, D. K. Basic principles of retinal detachment operations, with special reference to eyeball shortening operation. Trans. Amer. Acad. Ophth. and Otolaryn., 1945, v. 49, p. 155.
[13] ———, and Miller, M. Retinal detachment cured by eyeball shortening operation; report of case. Arch. of Ophth., 1939, v. 22, p. 974.
[14] Morgan, O. G. Excision of ciliary staphyloma. Trans. Ophth. Soc. United Kingdom, 1943, v. 43, p. 182.
[15] Spaeth, E. B. The principles and practice of ophthalmic surgery. Ed. 3, Philadelphia, Lea & Febiger, 1944, p. 567.
[16] Vail, D. Equatorial scleral staphyloma and retinal detachment cured by excision. Amer. Jour. Ophth., 1941, v. 24, p. 403.
[17] Wiener, Meyer. A surgical experiment in changing the refraction of the eye. Proc. Soc. Exp. Biol. and Med., 1940, v. 43, p. 384.

RETINAL HEMORRHAGE AS SEEN IN AN ATOMIC-BOMB CASUALTY

KARL B. BENKWITH, M.D.
Montgomery, Alabama

The writer was recently stationed in Japan as Force Surgeon on the staff of Marine General Ray Robinson, the Commanding General of the Fukuoka Occupation Force. We were the first troops to arrive and assume occupation control of Northern Kyushu and Southern Honshu, Japan, early in September, 1945. Located in Fukuoka was the Kyushu Imperial University and its medical school, which hospitalized many atomic-bomb patients from both Hiroshima and Nagasaki.

Through the courtesy of Drs. Tamura and Ikui, who directed the Ophthalmic Institute of the Kyushu Imperial University, the illustrations for the case herewith reported were made available.

The patient was a Japanese girl, aged 14 years, showing retinal hemorrhages as a result of the atomic-bomb explosion at Nagasaki, Kyushu, Japan, on August 9th.

The salient fact was that this patient suffered from excessive gamma-ray irradiations, which produced her clinical picture. She was first observed early in

Fig. 1 (Benkwith). The patient on October 10, 1945. Recent symptoms were petechiae in the skin, slight epilation, bleeding from the gums, and blurred vision.

September when an American-Japanese medical investigation team proceeded to Nagasaki to appraise the effects of the "bomb" on a cross section of the Nagasaki population. She was discovered to be ambulatory, although she had earlier suffered from malaise, headache, fever, nausea, and diarrhea. It was later (fig. 1) that she noted petechiae in her skin, slight epilation, bleeding from the gums, and blurred vision.

She was hospitalized for observation at the Ophthalmic Institute, Kyushu Imperial University at Fukuoka, where initial blood studies showed a leucopenia of 2,200 white blood corpuscles, prolonged bleeding time, decrease of platelets, and an anemia of 2.2 million red blood cells. She showed no evidence of blast wounds, cuts, or burns. She was approximately one mile from the accepted hypo-center of the atomic-bomb explosion, in her home, which was demolished at that time.

Examination of the fundi early in September showed a similar picture in each eye; that is, one of massive preretinal hemorrhages and hemorrhages into the fiber layer of the retina (fig. 2). These hemorrhages were distributed about the discs and in close association with the retinal vessels for approximately three disc diameters peripheral to the discs. In the macula of the left eye was a large sausage-shaped hemorrhage appearing to be fed by the terminal arterioles and venules of that region. Small, fluffy, white exudates, were scattered about the disc and in close approximation to the retinal vessels of greater caliber.

During hospitalization the patient remained ambulatory and received little specific medication except iron, persimmon-leaf extract, plus the Japanese diet of rice, vegetables, and tea. The ill effects of the excessive radiant energy on this patient gradually subsided, so that by November there was a definite clearing of the fundi. The retinal hemorrhages were absorbed faster than the whitish areas of apparent serofibrinous exudate, which also disappeared. Very little evidence of pathologic change was visible in the fundi by December. However, in the fundus of the left eye a small white, although more discolored, area persisted. This is shown in the drawing to lie just inferior to the macular region. The vitreous was clear of floaters, and the vision returned to normal. The patient's general physical condition showed improvement which coincided with the improved ocular findings. She was pronounced well and recovered at the turn of the year.

400 Norman Bridge Road (6)

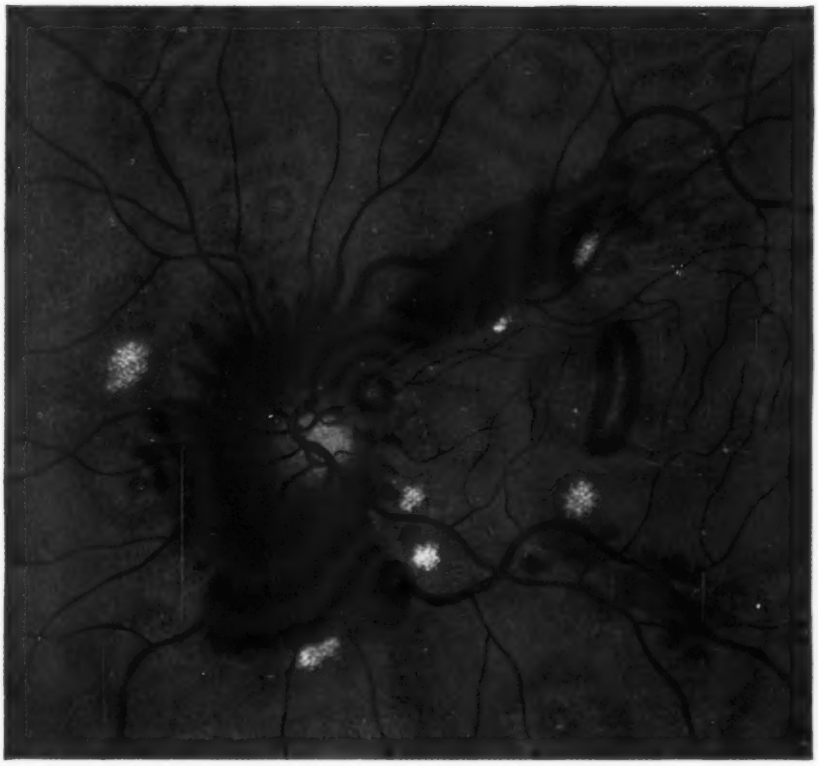


FIG. 2 (BENKWITH). FUNDUS OF THE LEFT EYE, SHOWING MASSIVE PRERETINAL HEMORRHAGES AND HEMORRHAGES INTO THE FIBER LAYER OF THE RETINA. A LARGE SAUSAGE-SHAPED HEMORRHAGE APPEARS TO BE FED BY THE TERMINAL ARTERIOLES AND VENULES OF THAT REGION. SMALL, FLUFFY, WHITE EXUDATES ARE SCATTERED ABOUT THE DISC AND IN CLOSE APPROXIMATION TO THE RETINAL VESSELS OF GREATER CALIBER.

UNIV. OF MICH.

SOME EFFECTS OF VITAMIN-A DEFICIENCY ON THE EYE OF THE RABBIT*

IDA MANN, A. PIRIE, K. TANSLEY, AND C. WOOD
WITH THE TECHNICAL ASSISTANCE OF M. BARNETT
Oxford, England

It is well known that nutritional or deficiency disease is responsible for widespread disorders of sight. The Report on Nutrition in the Colonial Empire (1939) states that ". . . diseases due to deficiency of vitamin A are perhaps the most common of all in the Colonial Empire. There are reports from a wide selection of territories of affections of the eye, nightblindness, xerophthalmia, keratomalacia . . . the prevalence of Bitot's spots and xerosis of the skin and hair are probably also due to insufficiency of vitamin A." This report has been supported by D. F. Moore (1940), who states that in the Philippines half the children attending hospitals had xerophthalmia, that in the Dutch East Indies, 4,000 children in half a million were blind, and that this high incidence is attributed to xerophthalmia.

Although much work has been done on the subject since the discovery of accessory food factors by Hopkins (1912), there are still certain gaps in our knowledge of the effects of vitamin-A deficiency on the eye. It is well known that the most striking general change in both man and experimental animals is a metaplasia of the surface cells of epithelia in the direction of the squamous and keratinized type. The epithelial metaplasia is always in the direction of simplification to a less highly specialized type; for example, mucous membranes lose their mucous cells and become uniform and keratinized. This change tends not to involve the basal cells, so that regeneration is usually possible and rapid. The surface involvement is widespread, affecting both ectodermal and endodermal epithelia so that many remote and superficially unrelated clinical effects are produced; for example, effects on the eyes, the skin, the lungs, the vagina, many glandular organs, and the central nervous system.

In addition to the fundamental epithelial change, various observers have described effects on the growth of blood vessels (for example vascularization of the cornea, Wolbach and Howe, 1925), effects on the resistance to infection of various organs, pigmentary and bony changes, and changes in nerve fibers. The papers reporting these changes have recently been summarized by Bicknell and Prescott (1942) and by Wolbach and Bessey (1942).

Although the main effects on the eye (nightblindness and xerophthalmia) are known with certainty, there still remain many details that are obscure. In the first place, we are not certain how much of the eye change is primary and directly due to the deficiency and the resulting epithelial change, and how much is secondary, due either to infection or to changes in the lacrimal glands, in bone, or in the nervous system. We do not know precisely the time relationship between the various clinical signs, nor the relation between the level of vitamin A in the blood and the histologic appearances of the eyes. Neither do we know the early biomicroscopic appearances, nor their relation to the histology.

We have, therefore, made a study of the condition in rabbits and have drawn certain conclusions about to be discussed for this species. It must be fully under-

* From the Nuffield Laboratory of Ophthalmology, The Eye Hospital, and The Oxford Nutrition Survey, 10 Parks Road.

stood, however, that a direct argument from rabbits to man is inadmissible in detail for three reasons: (1) The physiologic requirements of rabbits are not identical with those of man, so that the same sequence of similar clinical signs may not hold good for both. (2) Since the conjunctiva of rabbits is not normally exposed to the air, changes characterized by dryness in man may be somewhat different in appearance in rabbits. (3) Since alterations in retinal function cannot at present be detected in rabbits, structural retinal change alone has been considered in this paper, and no conclusions as to nightblindness can be drawn.

Before proceeding to a detailed description of the experiment and the findings, it is advisable to state briefly the conclusions we have arrived at for rabbits. These all confirm Wolbach and Howe's (1925) that the primary action is on epithelium:

1. The primary effect of vitamin-A deficiency on the eye is an epithelial change. This appears first on the cornea and can be detected here with a slitlamp, one to three months before it is visible with the naked eye, and often two to three weeks before it can be diagnosed with certainty by means of a loupe.
2. A pigmentary change in the conjunctiva (of pigmented rabbits) appears simultaneously with, or slightly after, the corneal change and can first be seen with the slitlamp.
3. A surface conjunctival change can be detected with the slitlamp some time later than the pigmentary change.
4. Any changes that there may be in the lacrimal gland are not the cause of the corneal change, which appears first.
5. The substantia propria, the corneal endothelium, and the corneal nerve fibers are not abnormal to slitlamp examination; neither were retinal changes observed with the ophthalmoscope or histologically.
6. Corneal vascularization and infiltration do not occur as part of the deficiency syndrome.
7. Signs of deficiency were usually established with no signs of concomitant infection. In a few cases apparent infection developed later than deficiency signs. This may account for vascularization of the cornea in the rare cases in which this occurs. No bacteriologic examinations were made.
8. The younger the rabbit at the beginning of the experiment the shorter the time required to produce changes in the eyes.
9. Correlation between plasma vitamin-A levels and time of onset of eye changes shows that the blood level sinks to about 10 percent of the normal before any eye change can be detected.
10. The eye changes described, apart from those produced by gross secondary infection, can be reversed by treatment with vitamin-A, the corneal change disappearing first, before the plasma vitamin-A is normal, and the pigmentation of the conjunctiva last.

Experimental methods

Rabbits were used, since they are easily rendered deficient in vitamin A and are docile under repeated slitlamp and other examinations. In addition, they present a larger area of conjunctiva for observation than do rats or guinea pigs and also frequently show limbal pigment rings similar to those seen in Africans and some other pigmented races. Their intraocular structure (for example, depth of anterior chamber) is more similar to that of man than is that of most other convenient laboratory animals.

Sixty rabbits of mixed laboratory stock were used. Fifty were rendered vitamin-A deficient and 10 were litter-mate controls. The rabbits were chosen mainly for eye color. Most were from a crossed Dutch strain with blue or heterochromic irides and a limbal pigment ring. As will be seen later, the stock was not entirely free from congenital abnormalities, one rabbit having a coloboma of the nerve sheath and others showing minor retinal abnormalities. Otherwise the animals were all healthy.

The deficiency was induced in two age groups. The first was composed of healthy weaned rabbits put on a vitamin-A–deficient diet when aged five to seven weeks. There were eight of these. Those in the second group were younger, their nursing does being put on an A-deficient diet as soon after the birth as possible. This diet was continued to the young afterwards, which could, therefore, be

said to have received an A-deficient diet from three to four weeks of age.

DIET

A diet of crushed oats plus 1.5-percent powdered chalk mixed and made just damp with water was fed *ad libitum*. In addition, water was freely available, and 5 mg. ascorbic acid, mixed in a spoonful of bran for convenience of measurement, was given to each rabbit each day.

Percentage analysis of crushed oats (Bull. No. 48, Ministry of Agric. & Fish.)

Protein	Oil	Carbohydrate	CaO	P_2O_5
10.3	4.8	58.2	0.14	0.81

B complex g/100 gm. wet crushed oats (Burkholder, 1943)

B_1	B_2	Nicotinic Acid	Biotin	Pantothenic Acid	Pyridoxin	Folic Acid
113	8	75	9	75	3	220

The chalk was added to bring the calcium/phosphorus ratio of the oats near unity in order to diminish the need for vitamin D. Rickets has not been reported in rabbits, and in general no vitamin D was given to the experimental animals; but some of the young rabbits put on the diet at the age of three weeks were given one or two weekly doses of 200 I.U. irradiated ergosterol. They showed no difference in growth rate nor in the development of vitamin-A deficiency. The grown rabbits ate about 75 gm. (dry) of the diet per day. Controls were given the same food with about two ounces of greens, or a daily dose of about 500 I.U. of vitamin A by mouth. The "A Controls" grew at about the same rate as those receiving greens, reached a normal body weight, and appeared healthy in every way. Attempts to improve the growth rate of rabbits given vitamin A during cure of the

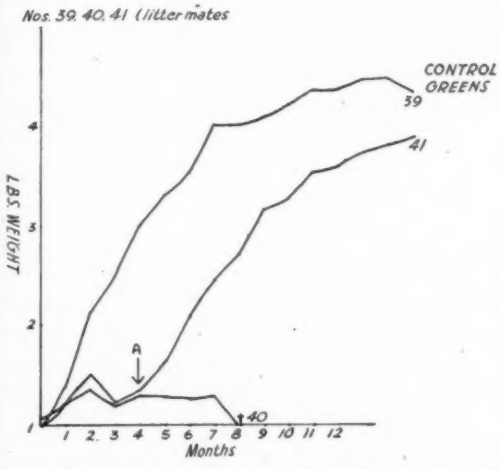


Chart 1 (Mann *et al.*). Growth curves of three litter mates. No. 39 was fed greens throughout. No. 40 died after eight months on the deficient diet. No. 41 was dosed with vitamin-A concentrate after four months' deficiency.

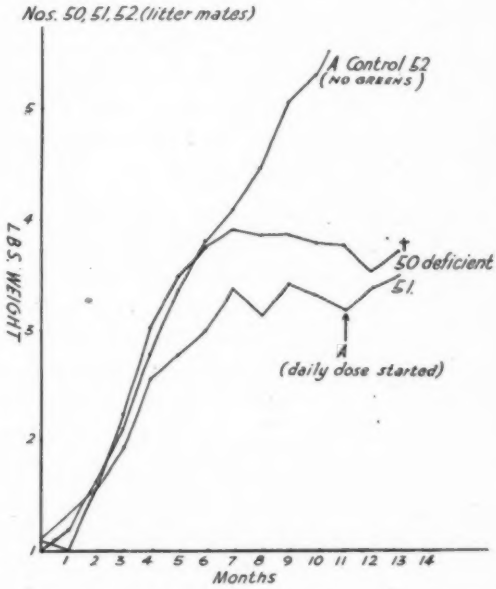


Chart 2 (Mann *et al.*). Growth curves of three litter mates. All were given one dose of about 1,000 I.U. of vitamin A at start of experiment (three weeks old). No. 52 was given vitamin-A concentrate throughout life. No. 50 was on deficient diet for 14 months, and No. 51 was cured with vitamin-A concentrate after 11 months' deficiency.

deficiency by addition of 5-percent casein, or 5-percent dried brewers' yeast to the diet made no noticeable difference. The rabbits were weighed once a week. Charts 1 and 2 show the growth curves of two litters, each having control and experimental animals.

Vitamin A was given by mouth either as Prepalin (Glaxo) or as a solution of vitamin A in arachis oil. The dose was approximately 500-1,000 I.U. per day per rabbit. A large dose was purposely chosen to get rapid cure.

Estimation of vitamin A in the blood

Blood was taken before the morning feed from the marginal ear vein into citrated tubes. Three to 5 ml. of plasma was stored in ice overnight and then the carotene and vitamin-A content were estimated by the following method, a modification of that described by Yudkin (1941): 2.0 ml. of the plasma was pipetted into a 15-ml. test tube and 2.0 ml. 95-percent ethyl alcohol added drop by drop, the tube being well shaken after each addition; 4 ml. of petrol ether (B.P. 40° to 60°) was then added, and the tube was well corked and shaken by hand for 10 minutes. The layers were allowed to separate, and 2.0 ml. of the petrol-ether layer was transferred to a colorimeter tube; 0.25 ml. of petrol ether was added, and the carotene measured in a photoelectric colorimeter with a 440-millimicron filter. After the petrol ether had been evaporated off on a waterbath at 55° to 60° and then for a few seconds at 70°, the residue was dissolved in 0.2 ml. of anhydrous chloroform, one drop of acetic anhydride was added, and the tube placed in the colorimeter with the light intensity already adjusted (620 millimicron filter). Then 2.0 ml. of Carr-Price reagent was added to the tube in position from an automatic pipette and the maximum temporarily steady galvanometer deflection recorded. The tube was removed at once and the result discarded if the solution was turbid. Galvanometer readings were converted to I.U. carotene and vitamin A per 100 ml. plasma by reference to calibration curves.

The rabbits were inspected frequently, and at least once a week were investigated thoroughly with a slitlamp. As soon as the signs of deficiency had reached the desired stage, one eye of the rabbit was removed (under intravenous nembutal anesthesia) for sectioning. Portions of the conjunctiva, lids, and lacrimal and Harderian glands were taken at the same time. The animal was then treated with vitamin A, and the progress toward cure was observed in the remaining eye. When improvement appeared maximal, the rabbit was killed, and the tissues of the second eye were sectioned.

Clinical course of the deficiency

The *first sign* of any effect from the deficient diet was a failure to gain weight at the same rate as the litter-mate control. The second sign was the appearance of a change in the corneal epithelium detectable only with the slitlamp. The lag in weight appeared earlier and was more marked the younger the rabbit at the beginning of the experiment, a fact noticed also by Mellanby (1944), and, similarly, the corneal change appeared earlier in the younger rabbits. At its earliest appearance, this corneal change could best be described as a very superficial epithelial disturbance. A few of the surface cells in the central area of the cornea looked opaque and slightly greasy. Microscopic examination later verified that these were epithelial cells undergoing metaplasia into squamous and keratinized cells. At first only a few cells here and there were affected, but soon they spread uniformly over the whole central area, which then became opaque, but did not in most cases

reach the limbus. There was no green staining with fluorescein, showing that there was no loss of surface. Of the area of metaplasia only the central part stained faintly pink with eosin, indicating that the cells were keratinizing. Picric acid did not stain.

At first the substantia propria could be seen easily through the altered epithelium. It showed no change. Mouriquand, Rollet, and Chaix (1931) made slitlamp observations in A-deficient albino rats and found vascularization, interstitial infiltration, and edema of the substantia propria. Such changes did not appear in our experimental animals, even after long periods on the deficient diet. The nerve fibers were especially observed in some rabbits and did not change in appearance, number, or distribution during the experiment. Sauer (1939) made a histologic study of corneal nerve fibers in A-deficient rats and found that the nerves grow into the metaplasing corneal epithelium. He concluded that degeneration of the nerve fibers could not be a primary cause of the epithelial change.

Later, the epithelial cells in the central area became white and greasy, or foamy, in appearance and heaped up into a dense plaque, often showing vacuolization. This plaque might disintegrate and be shed, showing for a few days a smooth, clear cornea. A heaped-up plaque would then be formed again. There was no cellular infiltration into the substantia propria.

The squamous change could be seen with the slitlamp to extend beyond the central area, where it was visible to the naked eye. In some cases it extended to the limbus, although the white heaped-up opacity scarcely ever did.

In some cases the movements of the third lid across the eye produced patterns like wave marks on sand in the loose keratinized layer. In no case did an ulcer develop. Plate 3 shows a normal rabbit eye and a typical example of fairly severe deficiency.

The *second detectable eye change* was an outward migration of the chromatophores of the limbal pigment ring. This appeared simultaneously with, or slightly after, the corneal change. It led to the apparent widening and thinning of the pigment ring and finally to a smoky discoloration of the whole bulbar conjunctiva. It was readily seen with the naked eye and appeared comparable with the discoloration described by Treacher Collins (1930) as occurring in the pigmented races in man and in vitamin-A deficient animals. That it was due to migration of preëxisting chromatophores and not to a new development is certain, since only those animals with a pigment ring showed it. In a few of the rabbits one eye had a pigment ring and the other not. In these cases only the pigmented eye became "smoky." In one rabbit there was a gap in the pigment ring at the start, and during the experiment the chromatophores were watched, as they migrated first outward and then laterally from the ends of the gap, so that it finally almost disappeared, becoming nearly uniform with the general smokiness. In one instance only was any migration inward on to the cornea observed. This rabbit, which showed very severe changes in the corneal epithelium, extending right up to the limbus all round, also had a thick conjunctival discharge and may have been infected. The pigment migration on to the cornea had the appearance of an epithelial slide, such as occurs after injury, rather than a diffuse migration, and was not typical of A deficiency.

The *third eye change* to appear was an alteration (keratinization) of the conjunctiva, especially in the lower fornix. That this change, which antedates the corneal change in man, should be the last to show in rabbits is probably due to the

fact that practically no part of the rabbit's conjunctiva is normally exposed to the air. It appeared in rabbits a fortnight to three months after the first detectable corneal change and varied a good deal in intensity.

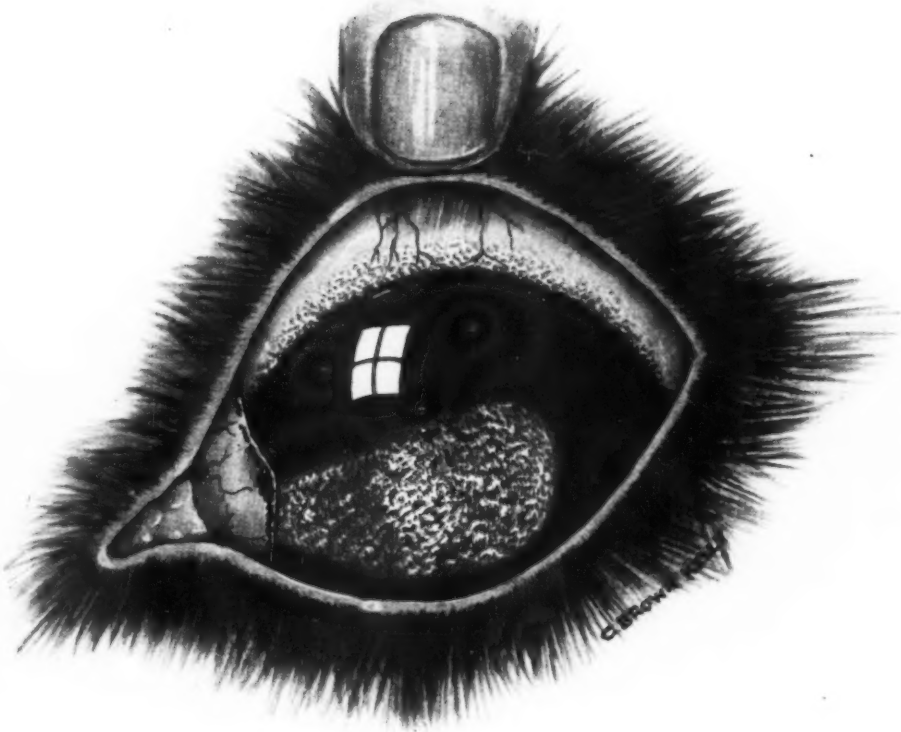
The white, greasy-looking surface accumulations in rubbing off the cornea and conjunctiva might appear as a thick white discharge. This was by no means always suggestive of infection; unfortunately, no bacteriologic tests could be made to clinch this point, but clinically the presence of coincident signs of inflammation —such as, redness of conjunctiva, swelling, eversion or ulceration of the lids— was taken as evidence of infection and not the presence of a foamy or greasy-white discharge alone. Thus, of six rabbits, four developed a severe ulcerative blepharoconjunctivitis with eversion and crusting of the lid margins. They were all in contact, and the condition occurred within 10 days in them all. In one of them, a slight vascularization at the margin of the cornea took place at the height of the inflammation. A fifth rabbit of this presumed-infected group had slight blepharitis and marginal vascularization, which cleared up during the cure of the A deficiency. Another rabbit also showed during the cure a similar but less-marked inflammation with marginal vascularization. Both inflammation and vessels disappeared rapidly under treatment with penicillin. In most of the rabbits we found no signs of inflammation and have no evidence, therefore, that, infection apart, corneal vascularization, infiltration. or ulceration, or conjunctival congestion is a necessary expression of A deficiency. Johnson (1943) found that treatment of the eyes with liquid petrolatum and metaphen ophthalmic ointment prevented corneal ulcers in rats with severe xerophthalmia. The effect is probably partly mechanical, the eye being kept lubricated by the ointment, and partly anti-infective.

All the conjunctival changes due directly to the A deficiency were of the same nature as those in the cornea. The occurrence of Bitot's spots (white areas of keratinization) in A-deficient rabbits has been reported by Hetler (1934), and recently Kruse (1941) has suggested that thickening and wrinkling of the conjunctiva may be an early sign in man. He states, however, that this change takes many months of treatment with massive doses of vitamin A to clear up, and, from his description, it is not certain whether a thickening of the surface epithelium or of the subconjunctival tissues is meant. The changes in our rabbits were purely epithelial and cleared up rapidly under treatment.

In some of the rabbits, general changes occurred which were of interest, but which were not especially studied. In some cases these appeared before the eye signs, and no definite time correlation could be obtained between them. The rabbits commonly looked ill and seemed listless, with poor appetites. In some, the head was held tilted, and the rabbit tended to move in circles; in three others, affections of the hind legs, paresis, and attacks of deforming arthritis occurred. A similar arthritis also occurred in one control rabbit receiving vitamin A, and in one stock rabbit in the colony. No pathologic evidence of the exact nature of these was obtained, although the nerves of the leg muscles of two of the A-deficient rabbits showed, on

Plate 3 (Mann *et al.*). A, Eye of normal rabbit. B, Eye of vitamin-A–deficient rabbit No. 2, after 9 months of deficient diet, showing characteristic corneal lesion and pigmentation of conjunctiva.

A



B

sectioning, no sign of present or past degeneration. We wish to thank Prof. J. Z. Young for preparing and reporting on these. One rabbit developed noisy breathing and several developed diarrhea.

Table 1 shows the relation between age of rabbit, time on deficient diet, and time of appearance of corneal, pigmentary, and conjunctival changes. General changes are not included.

TABLE 1

RELATION BETWEEN AGE OF RABBIT AND TIME OF APPEARANCE OF OCULAR SIGNS OF VITAMIN-A DEFICIENCY

Rabbit No.	Age at Beginning of Deficient Diet	Time on Diet at which Corneal Change Visible with Slitlamp	Time on Diet at which Pigment Migration Visible with Slitlamp	Time on Diet at which Conjunctival Change Visible with Slitlamp	Total Time on Diet
	weeks	months	months	months	months
1	7	7½	7¾	none	8
2	7	7½	7¾	8, slight	11
3	7	7½	8¼	—	10
6	7	4	4	7	14
7	7	4	4	4½	4¾
8	7	4	4	7	7
11	5	3	5	—	7
12	5	4	5	—	7
19	4	2	2	—	3
20	4	2	2	5	6
21	4	1½	2½	4	6
22	4	2	2½	—	2
23	4	2	3	—	6
54	4	2	not pigmented	?infected	5
55	4	1½	2	—	4
56	4	3¼	not pigmented	none	4½
57	4	none	slight, 3½	none	4½
15	3	2	not pigmented	none	2
16	3	2	1¾–2	none	5
18	3	2	2	none	4½
25	3	2¾	3	3½	7
26	3	1¾	2½	3	3
27	3	1¼	1¼	1¼	1½
28	3	1¼	1¼	—	1¾
31	3	2¼	2¼	none	2¼
37	3	1½	2½	—	2½
38	3	2¾	2¼	—	5
40	3	2¾	not pigmented	3	7
43	3	1½	?	?infected	2
45	3	1	?	?infected	2¾
48	3	¾	?	?infected	1¾
49	3	1¼	?	?infected	1½

CLINICAL COURSE OF THE CURE

This was much more rapid than that of the development of the deficiency. During the first few days of treatment there was an apparent worsening of the corneal condition, due to heaping up of the keratinized epithelium by the regenerating basal cells. This initial apparent worsening is very striking and was noticed by May and Wolff (1938) in a baby of seven months during treatment with cod-liver oil. In most cases, an improvement in the corneal condition was apparent in four days. The squamous cells were shed and did not reappear, and the cornea rapidly returned to normal. Often, large sheets of cast-off surface cells could be seen lying in the lower fornix and disintegrating into a thick, white discharge.

In some cases, the corneas were quite normal within a week of the administration of vitamin A; in others, slight changes could be detected for six weeks; the maximum improvement occurred early in all. As the cornea improved, the conjunctival discharge increased as all the surface cells were shed. In some cases the lining of the meibomian ducts was shed also and could be seen being extruded from their orifices. The pigmentation of the conjunctiva was the last macroscopic change to clear up. This occurred very slowly and seemed to be produced by disappearance of the migrated chromatophores and multiplication of the cells in the original pigment ring. In most cases it was not complete for three or four months, and in one, not for 15 months. It is, however, certain that if the animal is kept alive long enough all the abnormal pigmentation does eventually disappear, the eye becoming absolutely normal in every way.

The general condition also improved rapidly. The animal became lively, and the appetite improved. Structural joint change did not, however, recover, nor did the rabbits complete their growth, if this had been arrested. The rabbits which had received the deficient diet from three to four weeks weighed 3 to 4 pounds only, after prolonged administration of vitamin A. Whether this failure to reach normal size means that the diet was lacking in other factors or that the early arrest of growth permanently affected the skeletal and other structures we cannot be sure. It is, however, certain that the eye changes described are solely due to vitamin-A deficiency, since they were competely reversed by its administration.

Histologic methods and findings

Methods

The eyes, lids, and glands were fixed in Zenker's solution. In order to fix the retina quickly, the eyes were immediately injected with the fixative down the optic nerve before being immersed in it. Pieces of bulbar conjunctiva, including the ring of pigmented cells round the limbus, were removed and stretched out on a slide and fixed in 10-percent formalin in H_2O. They were flattened between two slides during fixation.

All the material was blocked in paraffin wax. Sections of the cornea were cut tangentially, as advocated by Pullinger (1943). Sections of the conjunctiva were cut transversely to show thickening and keratinization of the epithelium, while unstained flat preparations, to show pigment scattering, were also made by dehydrating, clearing, and mounting the strip of conjunctiva on the slide on which it was originally fixed. For the retinal preparations, parts of the back of the eyeball, including the visual streak (Davis, 1929) of the retina, were cut transversely at 10μ.

Weigert's hematoxylin with eosin or van Gieson's stain was used. Some conjunctival sections were also stained with mucicarmine, others with a safranin picroindigo-carmine stain for keratin, but results with hematoxylin and eosin were more detailed. The retinal sections were stained with hematoxylin and eosin by Feulgen's method and by a modification of the azan method in which the azocarmine is replaced by carmalum, as used in Wilder's silver method. For this modification the sections were mordaunted in 1-percent phosphomolybic instead of phosphotungstic acid.

Microscopic findings

Cornea. No histologic change was detectable for about a month after a change was easily visible with the slitlamp. The first detectable histologic change paralleled the appearance of a continuous central area of opaque epithelium.

There is general agreement as to the histologic appearance of the vitamin-A–

deficient cornea, but there has been some argument as to which of the changes observed may be regarded as primarily due to the deficiency

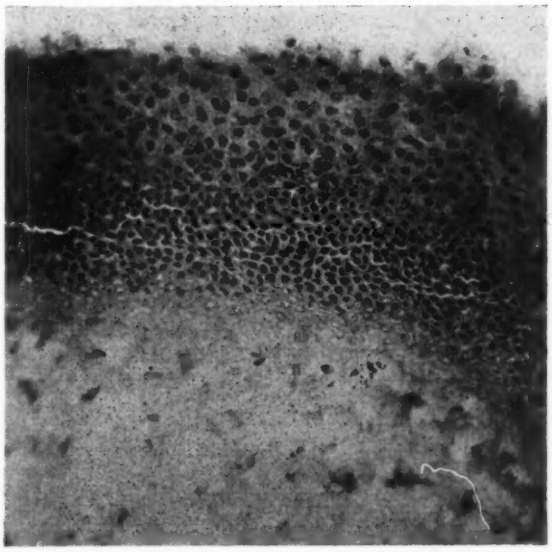


Fig. 1 (Mann *et al.*). Healthy cornea. Tangential section through surface layers of cornea of left eye of Rabbit 15 after 7 days on vitamin A. Staining: Zenker, Hematoxylin and eosin.

and which are merely secondary. All observers (Mori, 1922b: Yudkin and Lambert, 1921; Wolbach and Howe, 1925; Mellanby, 1934; Hetler, 1934) agree that the surface layers of the corneal epithelium become keratinized in all species of laboratory animal examined, including the rabbit, but while Wolbach and Howe believed this to be the primary change, Yudkin and Lambert as well as Mori were of the opinion that the corneal changes are secondary to infection (Yudkin and Lambert) or changes in the lacrimal glands (Mori). These workers were impressed by the fact that changes could be recognized in the conjunctiva while the cornea was still apparently unaffected.

Mori found infiltration and vascularization of the cornea in rats and sometimes ulceration and perforation. Wolbach and Howe, on the other hand, never found corneal ulceration in rats, although vascularization was common, whereas Hetler reported ulceration of the cornea in a monkey as well as in one eye of a deficient rabbit. In addition, she examined the eyes of deficient rats and guinea pigs, but only mentions corneal vascularization in the monkey.

In our rabbits, the surface layer of the corneal epithelium was always keratinized, but there was little alteration either

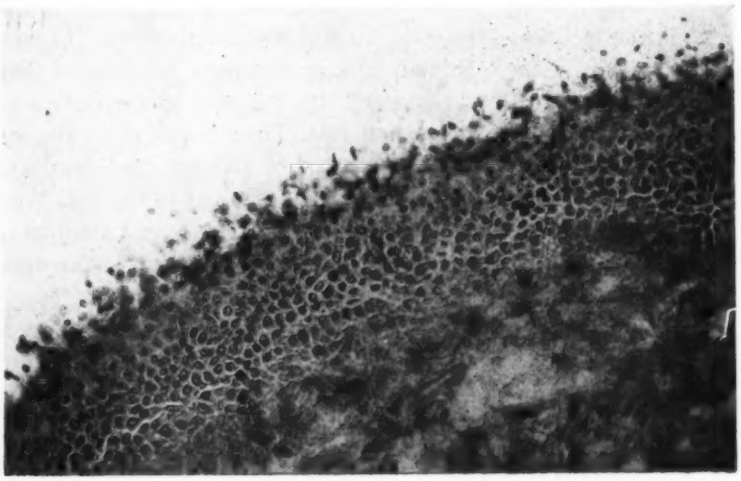


Fig. 2 (Mann *et al.*). Mildly deficient cornea of rabbit. Tangential section through cornea of right eye of Rabbit 15 after two months on deficient diet. The outer epithelial cells are unhealthy and in the process of being shed but are not yet keratinized. Compare figure 1 (left eye of same animal after cure). Staining: Zenker, Hematoxylin and eosin.

in the basal layers of the epithelium or in the substantia propria (figs. 2, 3). The number of dividing cells in the basal epithelial layers was slightly increased over the normal amount (cf. Wolbach and Howe, 1925, fig. 3) and there were possibly rather more pyknotic nuclei in the substantia propria. Infiltration was not common; we found polymorphonuclear cells in one animal and a little round-cell infiltration in one or two other corneas.

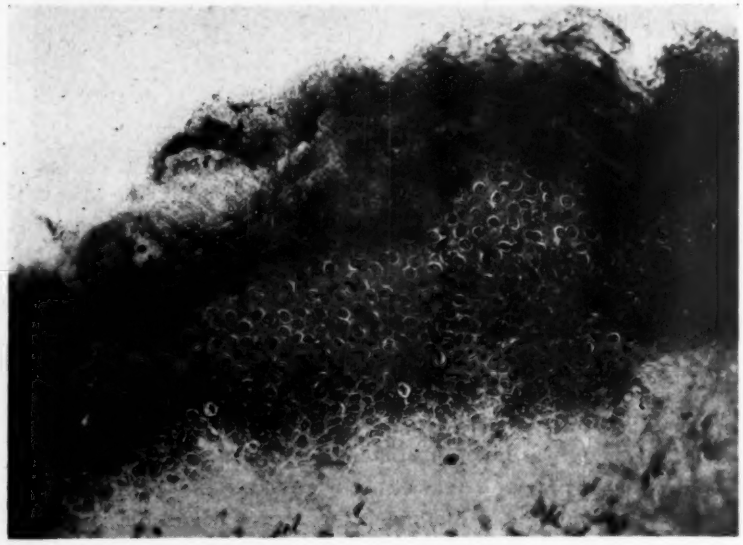


Fig. 3 (Mann *et al.*). Severely deficient cornea. Tangential section through surface layers of cornea of Rabbit 6 after 14 months on the deficient diet. The surface is keratinized. Note also mitoses in basal layer of corneal epithelium. Staining: Zenker, Hematoxylin and eosin.

Lids. Focal lesions with infiltration have been described by Yudkin and Lambert (1921) as an early change in vitamin-A deficiency of the rat, while Mori (1922a) found change in the meibomian glands of this animal, which, however, Wolbach and Howe (1925) declared to be insignificant. In rabbits we found some keratinization of the lining epithelium of the lids, but no other change; the meibomian glands appeared normal.

Harderian gland. The effect of vitamin-A deficiency on the harderian gland of the rat has been studied by Yudkin and Lambert (1921) and by Wolbach and Howe (1925). In this animal the deficiency leads to general atrophy of the alveoli and keratinization of the ducts of the gland; in the rabbit we were unable to demonstrate any change at all.

Lacrimal gland. Mori (1922a) described changes in the lacrimal glands of vitamin-A–deficient rats which he regarded as being the most important of all. He believed that, by putting an end to lacrimation, the lacrimal-gland changes were responsible for all the other ocular effects. Yudkin and Lambert (1921) confirmed Mori's findings but stated that the changes described by him may be seen in normal rats. Their paper gives the impression that they did not find the lacrimal gland much affected in the rat. Wolbach and Howe (1925) found atrophy of the tubules and keratinization of the ducts in the glands of A-deficient rats.

We found much the same changes as those described by Mori, Yudkin and Lambert, and Wolbach and Howe in our rabbits. The most marked of these was a loss of granular material from many of

the secreting cells, so that their cytoplasm appeared much less dense than normal. These cells were also swollen, so that the central lumen of the tubules affected tended to be obliterated. The nuclei often appeared normal but they were sometimes pyknotic or even missing altogether. Only some tubules of any given gland were affected, and the proportion remaining normal seemed to bear little relationship to the severity of the deficiency.

Fig. 4 (Mann *et al.*). Healthy conjunctiva. Transverse section through lower conjunctiva from left eye of Rabbit 38 after seven days on vitamin A. Staining: Zenker, Hematoxylin and eosin.

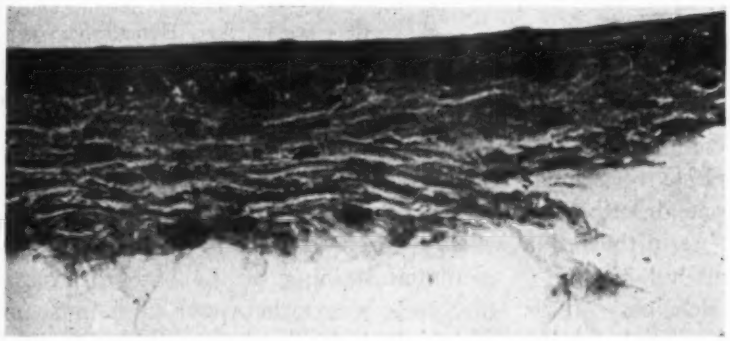


Fig. 5 (Mann *et al.*). Deficient conjunctiva. Transverse section through lower conjunctiva from right eye of Rabbit 38 after 2¾ months on deficient diet. The conjunctiva is much thickened and its surface keratinized. Compare figure 4 (left eye of the same animal after cure). Staining: Zenker, Hematoxylin and eosin.

The end result, even after treatment with vitamin A, was atrophy and fibrosis, although there was always a considerable number of normal tubules left. We confirmed Mori's observation that there are areas in which the tissue appears to be a simple mass of nuclei, but like Yudkin and Lambert, found the same phenomenon in the cured and control specimens.

Conjunctiva. It is generally agreed that vitamin-A deficiency leads to thickening and keratinization of the conjunctival epithelium. Mori (1922b) reports the finding of keratohyaline granules in the deficient conjunctiva of the rat (but not in the cornea), and Hetler (1934) in the monkey and in one rabbit eye; she does not mention their presence in any of her deficient rats but says specifically that they were not produced in the guinea pig, Yudkin and Lambert (1921) noticed focal infiltration in the conjunctivas of rats during the early stages of deficiency and, therefore, concluded that the corneal changes were secondary to infection of the conjunctiva. Treacher Collins (1930) refers to a case in which the conjunctiva of a man suffering from vitamin-A deficiency had no mucous cells.

We found keratinization and great thickening of the conjunctival epithelium with pigment in the cells of the basal layers (figs. 4 and 5). The stroma seemed fairly normal, although not entirely healthy, and there were some pyknotic nuclei. There was slight round-cell infiltration of the stroma in some, but by

no means all of the preparations. No mucous cells could be found in the deficient conjunctivas.

The retina. No changes in the appearance of the fundus have been reported in rabbits as a result of vitamin-A deficiency, and none were seen in these experiments.

Characteristic changes in the structure and staining reactions of the retinas of rats and dogs suffering from vitamin-A deficiency were first reported by Tansley (1933, 1936) and later confirmed in rats by Johnson (1939, 1943). Similar changes have recently been described by Anderson and Hart (1943) in the retina of the vitamin-A–deficient horse.

The first effect of this deficiency on the rat retina is a loss of differential staining of the inner and outer limbs of the rods with certain histologic stains. In the normal retina, Mallory's triple stain for connective tissues and its modifications, of which the modified azan technique already described is one, colors the outer limbs yellow and the inner limbs blue; whereas with Feulgen's method the outer limbs become purple and the inner green. In the deficient animal, the outer limb loses its characteristic staining reaction and is much less readily distinguishable from the rest of the rod. At a later stage the junction between inner and outer limbs becomes thin, and the retina tends to break at this point, leaving the outer limbs in contact with the pigment epithelium. Later still, the rods become ragged and unhealthy looking and are separated from each other and the pigment epithelium by large vacuolelike spaces. Johnson describes an even later stage in which the whole outer part of the retina disappears, but this was not seen either by Tansley or by Anderson and Hart.

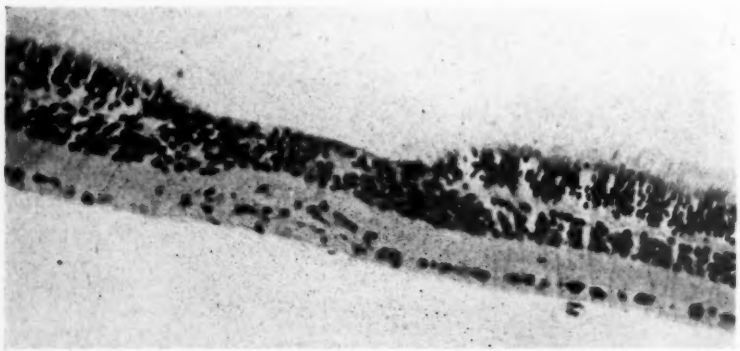


Fig. 6 (Mann *et al.*). Retinal degeneration. Transverse section through retina of right eye of Rabbit 7, showing small area where the rods and cones together with most of their nuclei have disappeared. The surrounding retina is normal. Staining: Zenker, Hematoxylin and eosin.

The rabbits in these experiments showed no retinal changes that could confidently be attributed to vitamin-A deficiency. In some of the retinas the differential staining of the outer limbs of the rods was rather poor, and in some there was a tendency to split between the inner and outer limbs, particularly in the central areas, but in no case was there any evidence of degeneration in any part of the rod outside the nucleus. Four animals (A7, A8, A9, and A19) had a number of degenerate *nuclei* in their retinas, both among the rod nuclei (outer nuclear layer) and the bipolar cells (inner nuclear layer), but these degenerations were confined to rather small areas in the central retina, and, although in some eyes they were associated with the breaking up of the rods, this was not necessarily the case. In A7 there was a relatively small

area where the whole retina outside the inner nuclear layer had disappeared completely, but the greater part of the retina was perfectly healthy (fig. 6). A8 had a coloboma of the optic-nerve sheath, a recessively inherited defect which is known to occur in rabbits (Koyanagi, 1921).

These degenerative changes are very like a form of retinal degeneration which has been observed by one of us (K. T., unpublished observation) in an inbred stock of albino rats and which was found to be inherited and often associated, possibly fortuitously, with coloboma of the optic-nerve sheath. They cannot be due to the vitamin-A deficiency in these rabbits, since the eyes in which they occurred were either from a control animal (A9) or were not removed until all macroscopic signs of deficiency had disappeared as a result of treatment with vitamin A; whereas several enucleated eyes, showing obvious corneal and conjunctival changes, had perfectly normal retinas. Three of the affected animals were litter mates (A7, A8, and A9) and this suggests that we have here an inherited retinal degeneration similar to that already observed in rats. These particular abnormalities were not present at birth in the rat, but appeared about two months later and gradually progressed during the life of the animal.

The occurrence of retinal abnormalities of this type is not uncommon in inbred rat stocks, and the present observations suggest that this may also be the case in rabbits. It is, therefore, of the first importance to make sure that any retinal degeneration observed never appears in litter mates of the same age before ascribing it to vitamin-A deficiency.

In general, the results of these experiments indicate that vitamin-A–deficient rabbits do not show the retinal changes which occur in rats, dogs, and horses.

Plasma vitamin A

It is of importance in assessing the value of slitlamp examination of the cornea in the early diagnosis of vitamin-A deficiency to know the relation between the blood level of vitamin A and the time of detection of the earliest eye signs. It is well known in man that nightblindness can be demonstrated before conjunctival and corneal changes become visible to the naked eye, yet few estimations of the plasma and carotene levels of vitamin-A–deficient animals appear to have been reported and related to eye signs. Rao (1936) reported that the liver of a vitamin-A-deficient rabbit showing xerophthalmia gave a negative antimonytrichloride test for vitamin A, and L. A. Moore (1939) found a rise in plasma carotene after feeding lucerne to vitamin-A–deficient calves which were nightblind but did not show corneal changes.

In our series of rabbits, the plasma carotene and vitamin A were estimated at irregular intervals, both during the establishment of the deficiency and during its treatment. Little or no plasma carotene was found, for the rabbit converts this rapidly to vitamin A. Briefly, we found that the plasma–vitamin-A values sank to about 10 percent or less of the normal before any sign of deficiency could be observed in the eyes with the slitlamp microscope (table 2). The reëstablishment of a normal blood level of vitamin A lagged behind apparently complete cure of the eyes. This is in accord with Lewis *et al.* (1942) who found that, in rats, retinal vitamin A remained high when blood and liver concentrations were reduced and that small doses of vitamin A, given to deficient animals, increased the retinal concentration to normal before there was much change in the blood vitamin A and before any detectable amount was laid down in the liver. Failure of

TABLE 2

RELATION BETWEEN PLASMA VITAMIN A AND EYE SIGNS

Rabbit No.	Plasma A I.U./100 ml.	Eye Signs	Plasma A of Control Litter Mate I.U./100 ml.
1	57	normal	150–177
	10	generalized corneal & conjunctival change	150–177
3	45	normal	150–177
	26	normal	150–177
11	73	normal	
	10	epithelial change just starting	
12	53	normal	
	15	epithelial change just starting	
23	10	very early corneal change	
31	10	normal	105
40	26	slight corneal and conjunctival change	104

dark adaptation in man can occur when the blood vitamin-A level is only slightly below normal, although individual variation makes the normal difficult to assess. The corneal and conjunctival changes that we have been describing must be considered as late changes relative to change in the level of vitamin A in the blood and probably to any change in dark adaptation.

One cannot argue directly from these results that corneal and conjunctival changes in man also will not be microscopically visible until the plasma vitamin-A level has fallen to about 10 percent of its normal value, but one must consider it as a possibility.

SUMMARY

1. Biomicroscopic and histologic changes in the eyes of vitamin-A–deficient rabbits have been observed and correlated with plasma–vitamin-A levels.

2. Plasma vitamin A was found to drop before any biomicroscopic change was visible.

3. The conclusions of earlier workers that the eye changes are primarily due to an epithelial change in the cornea and conjunctiva are substantiated.

4. Keratinization of the cornea and conjunctiva clears up very rapidly on treatment with vitamin A. Removal of conjunctival pigment and reëstablishment of the conjunctival mucous cells takes place more slowly.

It is a pleasure to thank Dr. H. Carleton for his help in preparing the photomicrographs.

REFERENCES

Anderson, A. C., and Hart, G. H. Amer. Jour. Vet. Res., 1943, v. 4, p. 307.
Bicknell, F., and Prescott, F. The vitamins in medicine. London, W. Heinemann, 1942.
Bulletin No. 48. Min. of Agric. & Fish., H. M. Stationery Office, London.
Burkholder, P. R. Science, 1943, v. 97, p. 562.
Collins, E. Treacher. Trans. Ophth. Soc. United Kingdom, 1930, v. 50, p. 201.
Davis, F. A. Trans. Amer. Ophth. Soc., 1929.
Hetler, R. A. Jour. Nutrit., 1934, v. 8, p. 75.
Hopkins, F. G. Jour. Physiol., 1912, v. 44, p. 425.
Johnson, M. L. Jour. Exper. Zool., 1939, v. 81, p. 67.
———. Arch. of Ophth. 1943, v. 29, p. 793.
Koyanagi, Y. Arch. f. Ophth., 1921, v. 114, p. 1.
Kruse, H. D. Millbank Memo. Quart., 1941, v. 19, p. 207.
Lewis, J. M., Bodansky, O., Falk, K. G., and McGuire, G. Jour. Nutrit., 1942, v. 23, p. 351.
May, Q. E., and Wolff, E. Lancet, 1938, v. 2, p. 252.

Mellanby, E. Proc. Roy. Soc. London, Ser. B., 1944, v. 132, p. 30.
———. Jour. Path. and Bact., 1934, v. 38, p. 391.
Moore, D. F. Jour. Trop. Med. and Hyg., 1940, v. 43, p. 257.
Moore, L. A. Jour. Nutrit., 1939, v. 17, p. 443.
Mori, S. (a) Jour. Amer. Med. Assoc., 1922, v. 79, p. 197.
———. (b) Bull. Johns Hopkins Hosp., 1922, v. 33, p. 357.
Mouriquand, G., Rollet, J., and Chaix, M. Bull. d'Histol., 1931, v. 8, p. 72.
Pullinger, B. D. Jour. Path. and Bact., 1943, v. 55, p. 97.
Rao, R. Ind. Jour. Med. Res., 1936, v. 24, p. 439.
Report on Nutrition in the Colonial Empire. 1939, H. M. Stationery Office, London.
Sauer, M. E. Anat. Record., 1939, v. 74, p. 223.
Tansley, K. Proc. Roy. Soc. London, B., 1933, v. 114, p. 79.
———. Biochem. Jour., 1936, v. 30, p. 839.
Wolbach, S. B., and Howe, P. R. Jour. Exp. Med., 1925, v. 42, p. 753.
Wolbach, S. B., and Bessey, O. A. Physiol. Rev., 1942, v. 22, p. 233.
Yudkin, A. M. and Lambert, R. A. Proc. Soc. Exp. Biol. and Med., 1921, v. 19, p. 375.
Yudkin, S. Biochem. Jour., 1941, v. 35, p. 551.

THE MANAGEMENT OF INTRAOCULAR FOREIGN BODIES IN MILITARY PRACTICE*

GEORGE M. HAIK, LT. COL. (MC), A.U.S.
New Orleans, Louisiana

Because ophthalmic care is so highly specialized, Army medical authorities found it desirable to designate certain hospitals in each theater of war as ophthalmic centers. The 64th General Hospital* was thus designated in April, 1944, and by successive directives continued to serve in that capacity until V-E Day. When the Hospital was first made the ophthalmic center for its area, it was established at Maddaloni, Italy, 45 miles below Cassino, and received large numbers of casualties during the heavy fighting there, particularly during the breakthrough in May. In August it was moved to Leghorn, 12 miles from Pisa, which the Germans still occupied, and for a month it received casualties directly, since there were no evacuation or field hospitals ahead of it. When the Gothic Line was breached and the Allied troops went forward, the situation again changed, and casualties again passed through evacuation, field, and general hospitals, sometimes not reaching the ophthalmic center at the 64th General Hospital until several days after their injuries had been sustained.

It is my purpose in this paper to summarize the observations made and the treatment employed in the management of intraocular foreign bodies during my service as head of the Ophthalmic Department of the 64th General Hospital. The data and conclusions are based on (1) a number of patients cared for at the 64th General Hospital immediately after being injured, who had received no preliminary treatment; (2) a number of patients cared for soon after being injured who had received treatment at a field or evacuation hospital; and (3) a number of patients cared for after a considerable period of time had elapsed since injury, who had been transported from a long distance, through field, evacuation, or other general hospitals. Total number of cases consisted of 311 eye injuries, with 252 battle casualties, 81 intraocular

* From the 64th General Hospital, Italy (the Louisiana State University unit).

foreign bodies, 14 double perforations of the globe, and a number of intracorneal, intrascleral, and intraorbital foreign bodies.†

In the War Between the States, according to Hughes,[1] injuries to the eye accounted for 0.5 percent of all wounds. In World War I the proportion rose to 5 percent. Detailed statistics on casualties

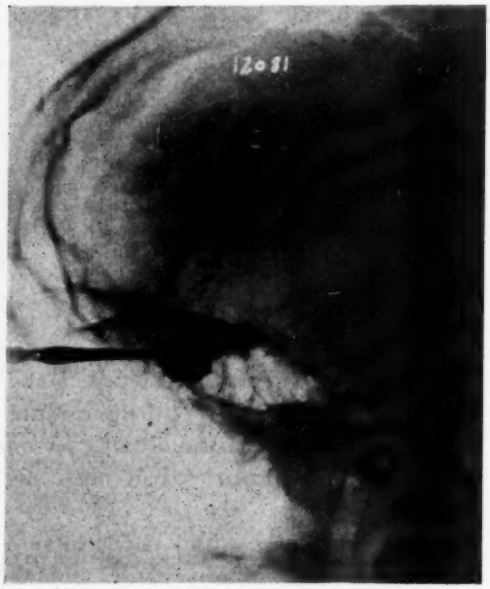


Fig. 1 (Haik). Case 1. Foreign body (shrapnel) lodged in apex roof of orbit having entered through vertex. Roentgenologic examination at operation with probe *in situ*. Transorbital removal.

for the present war are not yet available for publication, but probably the percentage of injuries of this type will show the same progressive increase noted in all the wars of the last century.

The actual incidence of injuries to the eye is even higher than published statistics indicate, for at least two reasons: In the first place, statistics are usually made up without regard to cerebral injuries with which wounds of the eye are associated. At the 64th General Hospital, for instance, some 10 percent of the intracranial foreign bodies observed entered through the orbit (fig. 1), the eye being irrevocably damaged in most instances in which the patients survived. In the second place, the incidence of foreign bodies is not always apparent in the immediate tabulation of injuries. It is augmented by the cases in which the injury is not immediately apparent, usually because of the predominance of associated wounds of the face, but becomes evident only by the later development of posterior uveitis. In many cases, of which the following is an example, the foreign body enters the eye without the soldier's knowledge of this phase of his wounds.

Patient 1 was admitted to the Ophthalmic Center at the 64th General Hospital from another general hospital five days after the development of an acute choroiditis of unknown etiology; several months previously he had been treated for wounds of the face. Examination with the slitlamp revealed a small hole in the iris, and upon roentgenologic examination (fig. 2 a, b) an intraocular foreign body was localized. Its removal resulted in almost immediate subsidence of the uveitis. Incidentally, the case illustrates the importance of roentgenologic examination in every instance of uveitis in young individuals, particularly those who have been in combat, for the demonstration of a possible foreign body (case 2).

Ophthalmic surgery under wartime conditions

An increasing incidence of injuries of the eye would naturally be expected as warfare becomes increasingly mechanized. On the other hand, in spite of the increase in the number of such injuries, the careful application of modern therapeutic methods gives ground for hope of

† Acknowledgment is made to Major Arthur V. Hayes, Gulfport, Mississippi, for invaluable aid in the management of these cases.

a decrease in the number of cases of both absolute and relative ophthalmic disability. The experience of the Ophthalmic Center at the 64th General Hospital supports this hope.

Since foreign bodies furnish one of the major ophthalmic problems of military service, it is fortunate that, even before hostilities commenced, the old concept—an eye containing a foreign body is potentially lost and must be promptly enucleated—was disappearing. The optimistic concept of other observers that many foreign bodies can be left in the eye without risk has been somewhat slower to disappear, however. With the possible exception of small particles of glass, aluminum, and certain new plastics, which are apparently inert, there is no ground for such optimism. All other foreign bodies, as the result of electrolysis and oxidation, act as irritants, and sooner or later may give rise to a chemical endophthalmitis. Certain special objects induce special varieties of inflammation. Those containing steel and iron, for example, give rise to siderosis bulbi, and objects containing copper give rise to chalcosis.

It is true that the removal of a foreign body from the eye is never unattended by risk. On the other hand, the risk is a calculated one, and is far less, most observers now believe, than that of permitting a foreign body to remain in the eye, however innocent its presence may seem. A devastating inflammation may be the result of such conservatism, as the following case shows:

Patient 2, who was wounded in action by a mortar-shell fragment, reached the 64th General Hospital 14 days later, after passing through an evacuation and then a station hospital. The only previous treatment had been the instillation of atropine twice daily. Examination showed a small metallic foreign body in the lens of the left eye (fig. 3). The lens seemed otherwise undamaged, and the eye showed no hemorrhage and no evidence of an inflammatory reaction. The patient had a severe bronchitis, and for this reason, and because the eye was quiet, no immediate treatment was instituted with respect to the eye. For eight days his course was uneventful. Then he suddenly presented a severe chemical endophthalmitis. Immediate Sweet localization revealed the foreign body lying 2.5 mm. below the horizontal plane, in the midline, 9 mm. behind the center of the cornea. It was removed (the patient under sodium-pentothal anesthesia) with a large magnet supplemented by the cataract knife when the particle had reached the surface of the lens. Postoperative therapy, in addition to the usual local measures, included triple-typhoid vaccine and penicillin. Recovery was stormy, and when the patient was evacuated to the United States, he

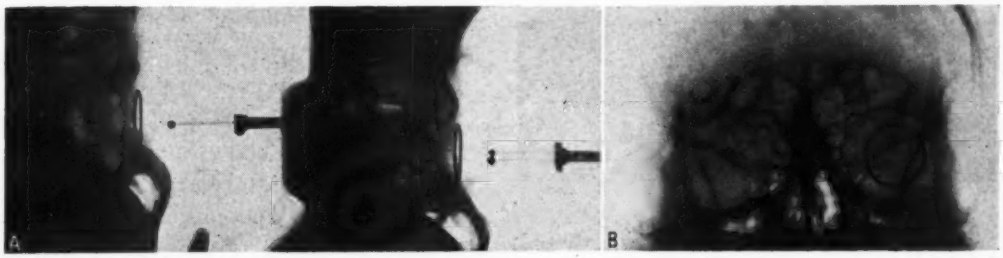


Fig. 2 (Haik). Case 2. A, Ring method of localization of foreign body. B, Sweet and ring method of localization.

had only poor light perception.

Ophthalmic surgery in wartime is attended with many difficulties. There is no branch of medicine that requires greater deliberation and delicacy, and there are fewer qualities more difficult to achieve in the circumstances of war, even in rear areas. In the forward areas, where the majority of injuries are sustained, the first attention is concentrated on saving

Fig. 3 (Haik). Case 3. Sweet method of localizing foreign body; foreign body 16 mm. in length, removal posterior sclerotomy. Visual results 20/30.

life, and other injuries often take precedence of injuries of the eye. Transportation to the rear areas is usually remarkably rapid, but necessarily depends upon the exigencies of combat; there are often unavoidable delays, even in injuries in which good results depend in large measure on prompt specialized treatment, while methods of transportation are often far from desirable.

Other difficulties also exist. The removal of foreign bodies from the eye by magnet is, generally speaking, the simplest method, but the proportion of nonmagnetic foreign bodies steadily increased during the war, as aluminum and magnesium alloys were increasingly substituted for brass and steel. Foreign bodies which enter the eye in combat are frequently larger than those seen in civilian practice, and, because of their high explosive origin, they frequently enter with great force and do great structural damage; the degree of explosive force, indeed, is more important than the length of the laceration through which the body enters the eye. The size of the object, though important, is not necessarily the deciding factor in the end result. At the 64th General Hospital some eyes were enucleated when the size of the object was less than 1 mm. in length, and others were saved when the length was more than 14 mm. (case 3).

The most important consideration in the end results of the surgery of foreign bodies is the condition of the eye when the patient is first seen, which implies that the earlier he is seen the more likely that results will be favorable. Generally speaking, foreign bodies must be removed within 48 hours after entrance, if an advanced chemical endophthalmitis is to be prevented. I have observed cells in the anterior chamber of the eye within an hour after injury, but as a rule, the most devastating inflammatory reaction does not occur for four to six days, as the following case illustrates:

Patient 3 was admitted to the 64th General Hospital six days after his left eye had been injured by shrapnel. When he was seen at an evacuation hospital, soon after the injury, his visual acuity was 20/30. The ophthalmologist there was of the opinion that he had suffered a double perforation of the globe and that the foreign body had entered a few millimeters from the limbus. The roentgenologist believed that the object was extraocular. For five days the soldier's course was uneventful. Then a severe chemical endophthalmitis developed, associated with a hazy cornea and numerous deposits on the posterior corneal surface. The iris was of a sickly green color and the aqueous was fixed. As soon as the patient reached the 64th General Hospital an intraocular foreign body was removed. Postoperative therapy included atropine instillations, foreign-protein therapy, and

sulfadiazine. Vision in the injured eye was 20/200 on discharge (case 4).

Important as is prompt attention to eye injuries, the belief that it is better not to attempt the removal of foreign bodies in forward areas, except in cases of extreme emergency grew steadily throughout the war. The delay in treatment which this policy involved was obviated, when circumstances permitted, by giving patients with such injuries priority in air evacuation. There were at least two good reasons for this policy. In the first place, intraocular hemorrhage, one of the most frequent causes of poor results in ophthalmic surgery, is likely to occur as the result of an initial injury and to be increased as the result of additional movement and manipulations; the length of time that the usual patient remained in an evacuation hospital was not sufficient to overcome this risk. In the second place, neither personnel nor equipment was likely to be highly specialized in forward areas, and the accurate roentgenologic localization essential for the removal of deep-seated foreign bodies was almost impossible to carry out in front-line hospitals. In one series of 17 cases in which foreign bodies were removed at the 64th General Hospital, attempts at removal in forward areas had been unsuccessful in 15, undoubtedly because accurate localization was impossible.

TABLE 1

ANALYSIS OF 81 CASES (11 BILATERAL) OF INTRAOCULAR FOREIGN BODIES TREATED AT THE OPHTHALMIC CENTER OF THE 64TH GENERAL HOSPITAL

Location	Number*
Anterior chamber	9
Lens	7
Vitreous or retina	
Entrance through cornea, iris, and lens	25
Entrance through cornea and iris	8
Entrance through sclera	32
Agent	
Mortar shell fragments	18
Other shell fragments	20
Mines	11
Grenades	9
Sniper's bullets	4
Hammer or chisel	12
Undetermined	7
Results	
Removal	63
Enucleation	7†
Evacuated in situ to United States	11

* These figures do not include 14 cases of double perforation of the globe, and a number of intraorbital and intrascleral foreign bodies.

† 2 magnetic, 5 nonmagnetic.

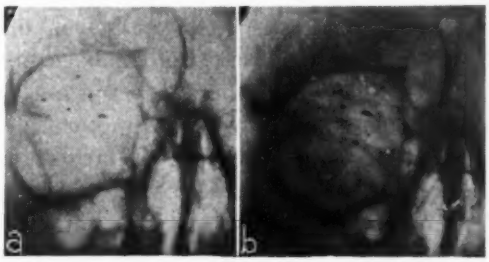


Fig. 4 (Haik). Case 4. Localization of foreign body by Waters method with lead beads on limbus at the 12-, 3-, 6-, and 9-o'clock positions. a, Patient looking upward. b, Patient looking downward.

Within the limits of the potential seriousness of intraocular foreign bodies, the results at the Ophthalmic Center of the 64th General Hospital were good. There were some tragic cases of complete blindness, but, as a rule, vision was preserved in the injured eye. It would be less than fair not to emphasize that whatever results were achieved at this center were by no means the achievement of the ophthalmic surgeons alone. For one thing, equipment was excellent. For another, the ophthalmic staff had the singular good fortune to have the coöperation of a competent and interested roentgenologic staff. In addition well-trained and enthusiastic nurses* and enlisted men† provided the

* Lieutenants Margaret Sexton, Mary Lowrance, Blanche Buquoi, Dorothy Rose, and Margaret Yound, and Miss Adelaide Stoll, A.R.C.

† Sergeants Lou Sadecky, David Reiss, and David Brein, and Corporal Ted Smeigilski.

patients with care which compared most favorably with that provided for such patients at the best hospitals in the United States.

The great majority of the intraocular foreign bodies observed at the 64th General Hospital, as an analysis of 81 typical cases shows (table 1), was of direct-combat origin or was combat-connected. Most of the others were sustained in the repair of vehicles, welding, chiseling, and similar activities. It must not be forgotten that a civilian life of sorts goes on behind the lines, and that injuries similar to those encountered in civilian life also occur. Singularly few injuries were due, as Stallard[2] expressed it, "to the stupidities of fools, who, in spite of warnings, dismantled mines and grenades, threw them about, suffered road injuries, etc."

Diagnostic considerations

Preëxamination care. Ideally, all soldiers with injuries of the eye were evacuated lying down and remained thus until the character of their wounds was determined, for the reason, already emphasized, that hemorrhage as well as loss of vitreous is a risk in all injuries of the eye and that the risk is increased many times by voluntary movements and careless handling. Practically, many soldiers not disabled by other wounds were received sitting up or even walking.

On admission to the Hospital, any patient with a suspected wound of the eye, regardless of its type, was immediately placed on a litter. He was moved very gently and was cautioned to keep both eyes closed, as if asleep, and not to make movements himself until the character of his injury was established.

History. In civilian practice, the history of an injury of the eye is frequently useful. It provides data concerning not only circumstances of the accident and the kind of foreign body, but usually also its force, direction, and possible infectiousness. In military injuries, the history is seldom of value, for even the type of weapon or shell used is often unknown. Therefore, potential infection must be assumed in all cases, regardless of the circumstances, although it may not be evident if the patient is seen promptly.

Examination. In cases of simple unilateral injury, the patient was placed in a partially darkened room, and pontocaine (0.5 percent) was instilled into both eyes before the examination. For more serious injuries, particularly the bilateral, local analgesia was secured with 4-percent cocaine solution, and adrenalin (1:1,000 solution) was instilled into the eyes in 2-drop amounts for four doses at 4-minute intervals. During this interim, sodium pentothal was administered intravenously, and no attempt at examination was made until the patient was fully relaxed. Black-silk sutures (4-0) were then placed in the upper and lower lids, in the areas in which procaine had been injected, and were used for purposes of retraction.

Thorough inspection with direct illumination was the first step of the examination. If hemorrhage and inflammation had not obscured the field, it provided useful information. In the majority of cases this was, unfortunately, not true. Hemorrhage had obscured the field, and the fundus reflex was absent. The examination was continued with the loupe and the ophthalmoscope; the slitlamp was used when feasible. The findings were correlated with the roentgenologic findings before any decision as to procedure was made.

Before discussing roentgenologic considerations, however, certain diagnostic considerations must be emphasized. It

was never assumed, because the lids were closed by hemorrhage or edema, or both, that the injuries were confined to the lids. These were gently retracted and intraocular foreign bodies were searched for, although it was sometimes necessary to delay the examination until compresses and other measures had reduced the edema and made manipulation possible without inflicting additional trauma. Intraocular examination was particularly necessary in cases of multiple wounds of the face, especially if edema and inflammatory reaction had already occurred when the patient was first seen. War ophthalmology provided no more difficult problems than delayed cases in which these changes had already obscured the intraocular field. The eyes in each such case were, therefore, thoroughly examined (the patient under sodium-pentothal anesthesia) and, if necessary, explored.

While the presence of a visible laceration of the cornea or sclera was regarded as presumptive evidence that a foreign body might have entered the eye, the absence of a visible wound was not considered adequate proof that it had not. A thin, small metallic fragment may leave no gross evidence of its entrance, particularly if some time has elapsed since the accident. When the staff of the 64th General Hospital worked close to the forward lines, or when patients were evacuated to it by air, the wound of entrance was usually visible. As the line went forward, or when patients were not seen until 24 hours or more had elapsed since their injuries, the wound of entrance was usually sealed and could not be demonstrated by any method of examination.

A prolapse of any portion of the uveal tract or of the vitreous, or a shallow deformity of the anterior chamber was regarded as *prima facie* evidence of a perforating wound with a possible intraocular foreign body.

A self-retaining retractor was never used in the search for a foreign body because it would exert pressure on the eyeball and contribute to the danger of loss of vitreous. Attempts to determine the presence of a perforating wound by pressure on the eyeball with the fingers or with a tonometer were also avoided. If a wound is present, such maneuvers inevitably cause the loss of vitreous.

The use of a magnet to test the presence of a foreign body was regarded as equally bad practice. If the body is nonmagnetic, the procedure is merely a waste of time. If it is magnetic, it may lie at too great a distance from the magnet, or be too small, or too deeply embedded in the tissues, to cause even a sense of pain until the instrument can be brought into closer contact with it. More important, if a magnetic foreign body is present and is susceptible to the pull of the magnet, a great harm may be done by even slight movement under noncontrolled conditions. Stallard's[2] suggestion that if fragments of the foreign bodies embedded elsewhere in the body can be removed, they should be examined roentgenologically to determine their constituents, seems to have definite limitations; for various explosives are made up of several different types of material. Some detonators, for example, as well as grenades and mines, consist of 90-percent nonmagnetic and 10-percent magnetic material. Furthermore, all the foreign bodies in a single case of injury are not necessarily of the same origin. Therefore, the practice of taking a foreign body from the face or other parts of the body to determine magnetism was not believed to be a reliable procedure.

Roentgenologic examination

Roentgenologic examination is the basic diagnostic method in cases of intraocular foreign bodies. Its success de-

pends chiefly upon the roentgenologist, since the ophthalmologist does not usually have the requisite training to employ it. Collaboration between the two staffs is therefore essential. At the 64th General Hospital it was the practice for a member of the ophthalmologic staff to be present throughout the roentgenologic examination, and both staffs were thus familiar with all details of all cases.

Examination began with a postero-anterior view of the skull, followed by a lateral view, in all cases of suspected intraocular foreign bodies and of all multiple wounds of the face. The use of the Waters position excluded the confusing shadow of the petrous bone. A quick reading of the wet films was followed by accurate localization by two methods. First, a silver ring 22, 24, or 26 mm. in diameter, was slipped into the cul-de-sac after local analgesia with pontocaine had been achieved. A double exposure on the same plate was taken with the patient looking upward and then looking down, and a second double exposure was taken on another plate, with the patient first looking to the right and then to the left. Then, an accurate Sweet's localization was done and, if there seemed a chance of error, was repeated at the same sitting. The coördinates and master charts which were now available eliminated much of the tedious calculation formerly necessary in applying this method. The localization of the foreign body by the Sweet method was checked against that indicated in the postero-anterior view, and if the lateral and vertical films varied, localization was repeated until all the films agreed.

Special precautions were taken in all roentgenologic examinations. Certain cassettes were used only for eye work, and were kept scrupulously clean. All exposures were rapid. The importance of cooperation was stressed to the patient, and no distracting movements and noises were permitted in the room. All films were checked while the patient was in the department and were repeated at once if there was any doubt as to their clarity. Only a few technicians, all of whom were carefully trained, were assigned to this work. They worked accurately because they knew that films must be made over if the findings of all methods of examination did not check with each other.

Errors are inherent in any method of localization, the most frequent arising from movements of the eye. In postero-anterior films this error was eliminated by having the patient look with the uninjured eye into an angled mirror at an object located laterally to him. If both eyes had been injured, the insertion of a silver ring helped to localize foreign bodies but did not completely exclude the error of movement or angulation of the eyeball or of the ring. The ring in a number of measured cases averaged 8 to 10 mm. behind the center of the cornea.

Several errors are possible in a double exposure on the same film, one of the most important being that a minute foreign body may not show up because it receives only half of the exposure ordinarily received. The foreign body may seem to be intraocular, while actually it is in the muscles, orbit, or fat, or in Tenon's capsule. Its presence in the eyelids was excluded by holding the lids open. Injection of air into Tenon's capsule followed by roentgenologic examination at several different angles, frequently clarified cases in which the foreign body had perforated the globe and lay just outside the sclera.

In several cases I found it possible to localize a foreign body by the use of four small lead beads sutured about the limbus in four different positions (case 5). Even if the patient should move, the foreign body was always in the same relationship to the beads. Sweet localization was done

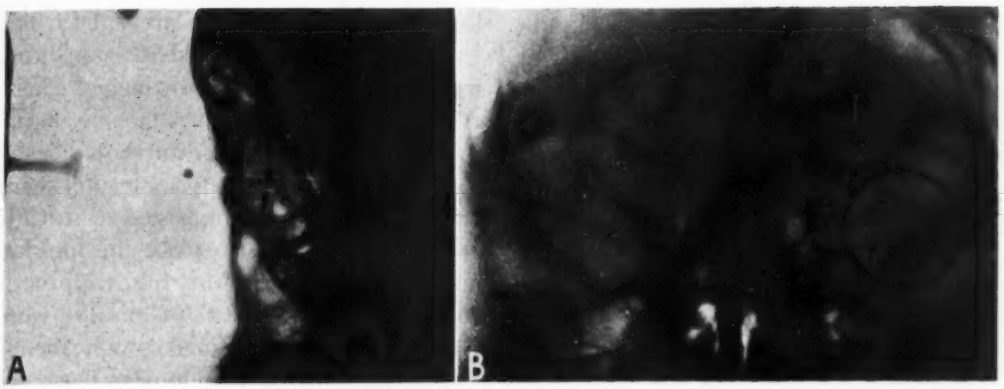


Fig. 5 (Haik). Case 5. A, Localization of foreign body 1 mm. in diameter. Lead bead at limbus, ring method. Sweet method of localization. B, Lead beads at limbus, ring method, Waters's view. Foreign body removed on third attempt through posterior sclerotomy.

with the beads *in situ*, and the results of the two examinations were checked against each other. This method is much simpler than the use of a contact lens (case 6), which is undesirable because it introduces additional trauma and because its fit is only fair at best, eyeballs varying greatly in size and curvature, and estimates of the degree of error being only approximate. Stereoscopy associated with the lead beads and ring often furthered localization.

If the particle was so small that its shadow did not appear on the first film, repeated films of different densities often revealed its position. The use of dental films for the anterior segment was considered important for the demonstration of small foreign bodies of low density.

When it was feasible, a repetition of the examination by a second roentgenologist, or a rereading of the plates, particularly if they had been read while wet, proved useful. Fluoroscopy was disappointing. Its only real value was in the case of nonmagnetic foreign bodies, which as a rule were of such low density or of such small size that they were obscured by the bony structures.

It was the practice at the 64th General Hospital to explore the injured eye in the region of the injury when the foreign body showed up in the double-exposure film as moving. The results of the examination were often inconclusive, and it was believed that the calculated risk of the operation was less than the risk of permitting a suspected intraocular foreign body to remain in the eye. It was also the practice to explore the eye in any case wherein there was reason to doubt a negative roentgenologic report

Fig. 6 (Haik). Case 6. Localization of foreign body with contact lens and lead beads. Angled mirror is in front of uninjured eye. Posterior sclerotomy removal.

and in any case wherein accurate localization was not successful, particularly if the foreign body were located 2 to 3 mm. from the sclera.

Mention should also be made of the foreign-body locator devised by Lieut. Col. Henry Carney on the principle of the apparatus used for detecting mines. While it was devised to locate foreign bodies elsewhere in the body, it was modified for use in the eye. It came into use shortly before the end of the fighting in Italy, and proved of value in confirming the X-ray findings.

Operation

The use of local analgesia was undesirable in military hospitals. The patients were frequently worn out and in a state of nervous tension when they were admitted; moreover, the inflammation so often present made complete anesthesia preferable. Sodium-pentothal anesthesia, supplemented by local analgesia, proved an ideal combination. It permitted maximum relaxation, and it was seldom necessary to section a muscle to expose the posterior sclera, which was often necessary when only local analgesia was used.

After the eyelashes had been clipped, the face was thoroughly washed with white soap and water, great care being taken to avoid pressure on the eyelids and eyeballs. The face was then wiped with 70-percent alcohol followed by tincture of merthiolate. Finally, argyrol in 10-percent solution was instilled into the eyes and was removed with copious irrigations of warm boric-acid solution.

Route of approach. Extraction of a foreign body through the wound of entrance was seldom feasible—a new incision usually had to be made. It was so placed as to permit removal of the object with the least possible trauma, and it was made longer than the object, to prevent further tearing, since a controlled incision heals more readily than one with jagged edges. Although there continues to be argument as to whether removal should be by the anterior or the posterior route, there seems little reason for disagreement. It seemed only logical to place the incision so as to permit the most direct approach to the object. Fragments of missiles were likely to be irregular and rough; hence damage to the ciliary body, iris, lens, and other structures was almost inevitable if these fragments were dragged through the whole extent of the eye in order to remove them by way of a corneal incision. An additional reason for placing the incision as near the foreign body as possible was that the magnetism of many modern instruments of war was so low that the magnet, to be effective, had to be placed near the object.

Prejudiced adherence to either the anterior or the posterior route was regarded as equally unwise. As a general rule, however, when the foreign body lay more than a few millimeters beyond the posterior capsule of the lens, it was usually considered wiser to remove it through a posterior rather than an anterior incision.

Points of technique. The technique employed for posterior sclerotomy was simple. The affected area was completely cleared of conjunctiva, Tenon's capsule, and episcleral tissue. A black-silk suture (4-0) in the sclera was used as a retractor. A black-silk suture (7-0) on an atraumatic needle was introduced into the sclera just to one side of the foreign body for a depth of 0.1 mm., and a similar suture was introduced on the same level and to the same depth just to the other side. An incision was made between these sutures, down to but not through the choroid, and the foreign body was re-

moved by magnet or forceps according to the indications; it was extremely important in dealing with minute foreign bodies to expose the choroid in view of their low magnetism. After the sutures were tied, the area about the incision was coagulated with the diathermy needle, to prevent detachment of the retina, a considered task in transcleral extraction. The episcleral tissue and Tenon's capsule were enclosed with interrupted silk sutures, care being taken that the incisions in the conjunctiva and sclera did not lie one above the other.

Corneal incisions and wounds were usually covered with conjunctival flaps and were sutured with atraumatic needles and with very fine black silk. The sutures did not penetrate more than half the thickness of the tissues.

If the foreign body lay in the anterior chamber or iris, eserine was instilled before the operation to contract the pupil, to keep the foreign body away from the lens, and to help prevent prolapse of the iris when the surgical incision was made. If the foreign body had perforated the lens and was lying in the vitreous posterior to it, making removal of the lens necessary, it was found that the best plan was to make the corneal opening just large enough to remove the foreign body, and to extract the lens at a second operation. This seemed advisable because vitreous is always present in the lens substance, and a large amount is likely to be lost if the lens and foreign body are removed together.

When a foreign body had been in the eye for any length of time, the vitreous was likely to be fluid and a large amount could easily be lost when the sclera was incised. Frequently, even a vitreous of normal consistency bulged into the wound. If this happened, the bulging portion was clipped off with scissors before the sutures, already placed, brought the cut edges of the sclera together.

Magnets. The small magnet, which was the only kind available in evacuation hospitals, was always used before the large magnet, if only because it was less awkward to manipulate. If it failed, the large magnet was applied. In the 64th General Hospital, successful removal of foreign bodies with a large magnet was possible in several cases in which the small magnet had previously failed. The difference between the two instruments, it should be emphasized, is not the increased magnetic attraction of the larger instrument, but the increased size of the magnetic field. Regardless of which is used, varying the distance between the patient and the tip of the magnet controls the degree of pull. In the ideal case, the tip of the magnet is applied either directly to the foreign body or at a distance of not more than 2 mm. Only after repeated attempts at more conservative methods have failed should probes, scissors, and other instruments be applied to the tip of the magnet, because when instruments are introduced into the vitreous, trauma is increased.

A magnet, whether large or small, was always used cautiously. It was never brought to the eye while alive. It was never used until the location and size of the foreign body had been determined as accurately as possible and the method of removal had been decided upon. Finally, it was introduced into the wound, as near the foreign body as possible, before the current was turned on. Repeated applications were sometimes necessary, and success was often achieved in most unlikely cases. Wright and Duncan[3] have recently reported two such instances. In the first 6/6 vision was preserved in a German prisoner after 35 applications of the magnet and in the other 6/9 vision was preserved in an English soldier after 75 applications totaling 10 minutes and ranging in duration from 4 to 15 seconds, in the course of four operations.

Enucleation. Although enucleation is now a last resort in the management of foreign bodies, it was sometimes found to be the wisest procedure in the occasional case in which the object had damaged all the tissues of the eye in its passage or in which there had been a long delay before hospitalization, with the development of serious infection. When the injury was bilateral, it was particularly important to delay radical surgery. Sometimes the eye which on the first examination seemed in worse condition later proved to have better vision.

Experiences at the 64th General Hospital bore out the value of conservatism. In some cases as many as three attempts to remove the foreign body failed, but, unless the eye became painful and soft or light perception was permanently lost, enucleation was still delayed. In one such case, the result of an explosion of a 37-mm. gun, three attempts to remove a fragment (probably of aluminum) in the vitreous failed at this hospital. A fourth attempt in the United States also failed. Exploration was carried out through both the anterior and the posterior routes. The eye, however, remained quiet, and good vision was maintained. When the soldier was first seen, other, more superficial fragments were removed without difficulty from both eyes. Some of these were magnetic; others, nonmagnetic. Roentgenologic examination was negative in this case, the foreign body having been seen only by ophthalmoscopy.

The development of chemical endophthalmitis, even if severe, was not regarded as indication for immediate enucleation if the foreign body could be removed. In numerous cases treated at this hospital, the infection was controlled by foreign-protein therapy, and at least partial vision was preserved. The staff also took the position that because of the risk of sympathetic ophthalmia, immediate enucleation was not indicated in cases of injury involving the ciliary body. In a number of instances, in one of which the fragment was a 16-mm. piece of shrapnel, the foreign bodies were removed and useful vision was retained. All such cases were followed up for a minimum of three months, and no instance of sympathetic ophthalmia was observed during this period.

Postoperative care

At the conclusion of the operation, 5-percent atropine sulfate was instilled into the eye, followed by sulfanilamide powder and 5-percent boric-acid ointment. The eyes were covered by a binocular bandage, and at the end of two weeks a pinpoint shield was permitted on the uninjured eye. It proved impossible to keep the injured eye at rest if only a monocular bandage was used. The patient was warned against violent or abrupt movements, was kept in bed for seven or eight weeks, and was so supervised by the nursing staff that these instructions were carried out.

The postoperative management did not differ from the methods used in the usual ophthalmologic case except that atropine sulfate was used in 5-percent strength instead of in the usual 1-percent strength. This was necessary because of the difficulty of securing good dilation of the pupil in young men, the majority of whom have unusually strong sphincters.

It was standard practice in all eye injuries to begin the administration of penicillin in the evacuation or field hospital; 25,000 Oxford units was administered every three hours with as little interruption as possible until 2,500,000 units had been given. Before May, 1944, when penicillin first became available, sulfanilamide and its derivatives were used in all eye injuries.

Foreign-protein therapy was begun in

cases of perforating wounds as soon as the patient reached the General Hospital. Fresh milk was not obtainable, but canned milk, which, so far as I know, has not previously been used in foreign-protein therapy, gave excellent results. It was used in 5-c.c amounts, mixed with 5 c.c. of distilled water, and was given five times every third day. No abscess resulted in more than 1,000 injections. The use of typhoid vaccine was usually undesirable when the patients were first seen, because many of them were in poor condition, if not in acute shock; however, if the eye continued irritable, it was employed later.

Infection was most likely to occur when the wound of entrance was through the cornea, and least likely to occur when it was through the sclera. The vitreous, fortunately, is a poor culture medium. In the cases in which chemotherapy had been instituted promptly, surprisingly few infections were observed at the 64th General Hospital, even when the patients were received late. Postoperative complications under the regime outlined were inconsequential.

Summary and Conclusions

The highly mechanized nature of modern warfare has caused a great increase in the number of injuries of the eye, but the application of modern therapeutic methods gives rise to the hope that the percentage of permanent and relative disability may be smaller than in previous wars.

Foreign bodies furnish one of the major ophthalmologic problems of military service. Their removal is never simple, but the risk of operation by a competent ophthalmologic surgeon, and under proper conditions, is less than the risk of their retention. Enucleation of the injured eye should be regarded as a last resort and never as the procedure of choice.

The exact localization of the foreign body by roentgenologic methods is the secret of successful removal. More than one attempt at removal may be necessary before success is achieved. Removal by magnet is desirable when it can be carried out, but an increasingly large number of missiles of modern warfare are nonmagnetic. The anterior or posterior approach should be used according to the indications.

The use of chemotherapy (penicillin and sulfanilamide and its derivatives) and of foreign-protein therapy (milk or typhoid vaccine) is successful in preventing and controlling infection in the majority of cases.

The removal of foreign bodies is attended with more difficulties in military than in civilian practices, but preservation of some degree of vision is possible in many unpromising cases. Even if enucleation must eventually be resorted to, the soldier should be given his chance for future vision, since conservation under proper safeguards, is not attended with undue risk.

812 Maison Blanche Building.

References

[1] Hughes, W. F. Management of injuries to the eyes. S. Clin. North America, 1942, v. 22, pp. 1355-1373.

[2] Stallard, H. B. War surgery of the eye. An analysis of 102 cases of intraocular foreign bodies. Brit. Jour. Ophth., 1944, v. 28, pp. 105-135.

[3] Wright, R. E., and Duncan, H. A. G. Experiences with the giant magnet and metallic intraocular bodies in recent battle casualties. Brit. Med. Jour., 1944, v. 2, pp. 658-659.

THE EFFECT OF SUNLIGHT ON DARK ADAPTATION*

BRANT CLARK, LT. COMDR. H(S), USNR, M. L. JOHNSON, LT. (jg) H(W), USNR, AND R. E. DREHER, LT. (jg) H(S), USNR
Pensacola, Florida

INTRODUCTION

Cases of night blindness attributed to exposure to excessive sunlight have been reported from time to time over a period of many years.[1] Although in most of these cases some dietary deficiencies may have been a causative factor, it seems likely, in view of recent reports[2, 3, 4] on night visual disturbances occurring in military personnel, that exposure to bright sunlight may well have been an important contributing factor.

Recently reported are 50 cases of night blindness in the Turkish Army which were apparently due to bright sunlight.[2] Livingston,[3] in a clinical study made in Iraq in 1932, found that constant exposure to sun glare resulted in definite clinical changes that are significantly detrimental to aviation, among other occupations. McCartney[4] has also reported that exposure to tropical sunlight caused severe night blindness among military personnel in the South Pacific; in most of these cases the day vision remained unimpaired. He states further that cases of night blindness due to sun glare are more severe when other constitutional factors, such as alcoholism, dietary deficiencies, and reduced vitality of whatever cause, are also present.

These reports are substantiated by laboratory studies showing that the speed of dark adaptation is greatly influenced by the brightness of the light to which the eyes are exposed prior to dark adaptation.[5, 6, 7] For example, it has been shown that adaptation to high intensities of light prior to dark adaptation will not only delay the onset of rod adaptation, but will also delay the attainment of the normal, final dark-adapted threshold. In view of the foregoing and the persistence of reports of night blindness from combat areas in the South Pacific, further investigations on the effect of excessive sunlight upon retinal sensitivity have been made.

Hecht *et al.*[8] undertook a study at Camp Lejeune in the fall of 1944, with the idea of determining how long the final dark-adapted threshold remains above normal after exposure to sunlight and whether such effects are cumulative in personnel exposed to sunlight day after day over a considerable period of time. They found that after a single exposure of two to three hours, the onset of rod adaptation was delayed for 10 minutes or more and the dark-adaptation process, itself, was delayed so that the normal dark-adapted threshold was not reached for several hours. After repeated daily exposures to sunlight, the night visual threshold remained elevated on an average of 0.11 log $\mu\mu$ lamberts above normal overnight. This degree of elevation amounts to a deterioration of about 50 percent in visual acuity, range of visibility, contrast discrimination, and frequency of seeing. Furthermore, this cumulative effect appeared to have some degree of permanence since it persisted even after 10 days of protection from sunlight.

Although there is ample evidence that prolonged exposure to sunlight has a deleterious effect upon night vision, the Bureau of Medicine and Surgery of the

---

* From the School of Aviation Medicine, Naval Air Training Bases. The opinions or assertions contained herein are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

Navy Department decided that additional data on certain practical aspects of the problem would be valuable. Two problems were considered to be of particular significance to Navy personnel assigned to duties involving the use of night vision: (1) the duration of the effects of sunlight on dark adaptation, and (2) the protection afforded by low-transmission sunglasses during exposure to sunlight.

The Naval Air Training Bases, Pensacola, Florida, offered a suitable place for these studies because there the bright sunlight and high reflectivity of the sand on the beaches closely approximate conditions of illumination found in the islands of the South Pacific. Furthermore, personnel and equipment were available for making the studies.

Experimental procedure

In the three experiments to be described, the testing of the subjects was done in the Night Vision Training Building, Naval Air Station, Pensacola. The building was ideal for the purpose, since it was lightproof, equipped with air conditioning, and had facilities for illumination by white or dim red light.

In each of the experiments, the subjects were tested in groups of 10 or less. In all cases each subject was dark adapted, prior to testing, by remaining in dim red light for 20 minutes and then in total darkness for 10 additional minutes. The dark-adapted thresholds of both the right and left eyes (or, in one experiment, of the sighting eye) were measured after 30 and 60 minutes of dark adaptation. In certain cases, thresholds were also determined after 90 minutes of dark adaptation.

The threshold measurements were made with a Hecht-Schlaer Adaptometer modified to present a 3-degree circular test patch. This was arranged to measure the monocular threshold of a retinal area 7 degrees above the macula. Each exposure of the test light was for one-fifth second. The method of limits was used to determine the threshold. The intensity of the test patch was decreased in 0.2 log $\mu\mu$ lambert steps until the subject did not see two successive exposures. The intensity of the test light was then increased until the subject reported two successive exposures. Ten such series of trials were given, five descending alternated with five ascending series of trials. The average of these 10 measurements was taken as the threshold for each condition of adaptation.

The subjects used in these experiments were obtained from two sources. Two small groups consisted of enlisted men assigned to the Dispensary, NAS, Pensacola. The remaining men were members of seaplane beaching crews attached to Squadron 8-A NATB, Pensacola. In each case, before the experiment was started, the testing procedure and the purpose of the experiment were carefully explained to the subjects. Preliminary thresholds, obtained before the experimental conditions were instituted, served as practice periods to familiarize the men with the testing procedure and provided a basis for comparison with the thresholds obtained under experimental conditions. The men were exposed to sunlight for varying periods of time which will be indicated in the following discussion of the studies.

Experimental results

The effect of excessive sunlight on the retinal sensitivity of an unprotected and completely protected eye in the same individual[9]

As a preliminary to an investigation of the protective value of sunglasses, an experiment was made to determine whether the effect of sunlight on retinal

sensitivity of an unprotected and a completely protected eye could be studied simultaneously in the same individual. This was done by measuring the monocular variation in night visual thresholds of four subjects who had one eye completely protected by a black eye shield during exposure to bright sunlight. After preliminary threshold measurements had been made, each man was issued a black eye shield and instructed to wear it over the right eye at all times while out-of-doors except after sundown. The men were sent to Mustin Beach on Penascola Bay every day except Sunday during the experiment. Throughout the experiment every day was sunny and bright. The men averaged 4 hours and 25 minutes a day on the beach, during which time they were permitted to do whatever they wished to amuse themselves so long as they did not close the exposed eye or protect it from the sun or sand in any way. After the morning tests on the 15th day of the experiment, the eye patch was reversed and worn on the left eye.

The combined data are shown graphically in figures 1 and 2. The afternoon data (fig. 1) show the immediate effects of excessive sunlight on the night visual thresholds, whereas the morning data (fig. 2) show any residual effect of the previous day's exposure. The difference in threshold, which was negligible at the beginning of the experiment, may be used as a measure of the effect of sunlight upon the exposed eye.

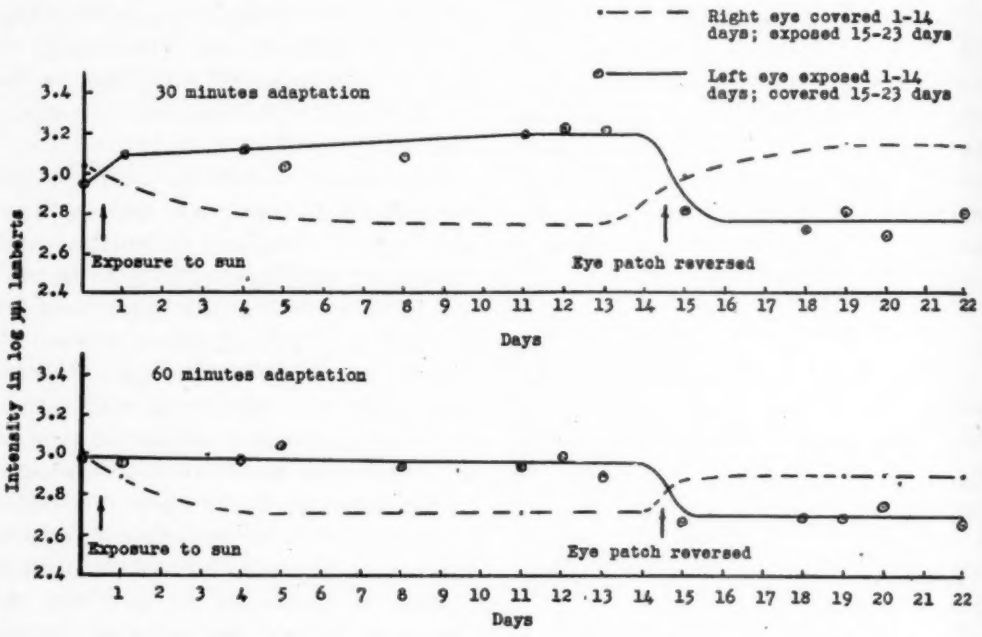


Fig. 1 (Clark, Johnson, and Dreher). Afternoon dark-adapted thresholds.

As would be expected, the effects of exposure to sunlight were most marked in the afternoon, immediately following exposure. It can be seen in figure 1 that the average afternoon thresholds of the exposed eye were always higher than those of the protected eye. After 30 minutes of dark adaptation, the differences in favor of the protected eye ranged from 0.11 to 0.50 log μμ lamberts, with an average difference of 0.34 log μμ lam-

berts (table 1). After 60 minutes of dark adaptation, the same effects were present to a lesser degree, the range for the group being 0.07 to 0.30 log μμ lamberts, with an average difference of 0.21 log μμ lamberts (table 1).

When the eye shields were reversed on the morning of the fifteenth experimental day, the thresholds taken that afternoon showed marked reversals (fig. 1). After 30 minutes of dark adaptation, the threshold of the formerly protected eye rose 0.30 log μμ lamberts above its previous, and presumably normal, level for the duration of the experiment. After 60 minutes of dark adaptation, an elevation of 0.20 log μμ lamberts persisted through the final eight days. On the afternoon of the first day it was protected from the sun, the previously exposed eye, now protected with a black shield, showed threshold drops of 0.35 and 0.25 log μμ

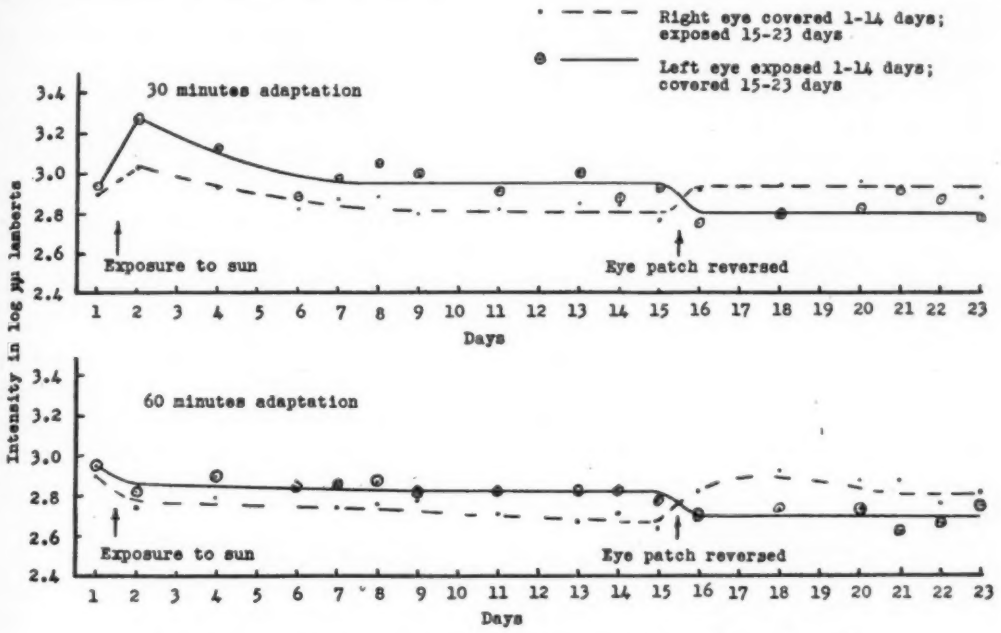


Fig. 2 (Clark, Johnson, and Dreher). Morning dark-adapted thresholds.

TABLE 1

AVERAGE THRESHOLDS OF EXPOSED AND COMPLETELY PROTECTED EYES

	Mean Morning Thresholds in Log μμ Lamberts			Mean Afternoon Thresholds in Log μμ Lamberts		
	Dark-Adaptation Times			Dark-Adaptation Times		
	30 min.	60 min.	90* min.	30 min.	60 min.	90† min.
Exposed eye	2.97	2.84	2.77	3.12	2.93	2.80
Protected eye	2.84	2.72	2.63	2.78	2.72	2.67
Average difference	0.13	0.12	0.14	0.34	0.21	0.13

* Final four days only.
† Final three days only.

lamberts after 30 and 60 minutes of dark adaptation, respectively. Furthermore, the thresholds of the previously exposed eye remained at this lower level through the remaining seven days of the experiment. On the last three afternoons of the experiment, thresholds measured after 90 minutes of dark adaptation showed that the exposed eye had reached in 90 minutes the level normally attained by the protected eye after only 30 minutes of dark adaptation (table 1).

The residuum of the effect of the previous day's exposure is shown in the 30- and 60-minute threshold measurements taken in the morning before the daily exposure to sunlight (fig. 2). The effect here was the same as that found in the afternoon data, except that the decrement of rod function in the exposed eye was less. After 30 minutes of adaptation, the average difference between the two eyes was 0.13 log μμ lamberts with a range of 0.10 to 0.44 log μμ lamberts. Following 60 minutes of adaptation, an average difference of 0.12 log μμ lamberts between the two eyes was present (table 1). After reversal of the eye shields on the fifteenth day, shifts in sensitivity similar to those present in the afternoon appeared in the morning data. The threshold of the formerly exposed eye dropped to the level of the previously protected eye, and that of the previously protected eye (now exposed) rose to the level of the previously exposed eye.

These data reveal effects of exposure to sunlight that are of the same order of magnitude as those found by Hecht *et al.* at Camp Lejeune.[8] Although the amount of the elevation in threshold is not spectacular, Hecht has pointed out that it is enough to reduce efficiency by approximately 50 percent at threshold levels of intensity. These results differ from those of the Camp Lejeune study, however, in that the effects of the exposure were found to be only temporary. In the present study, the elevation of threshold of the exposed eye disappeared when the eye was completely protected from light for a period of seven to eight hours during a day, while the other eye was exposed to brilliant sunlight.

A STUDY OF THE EFFECTIVENESS OF SUNGLASSES IN THE PROTECTION OF NIGHT VISION

Two studies were made to determine the effectiveness of Navy-issue sunglasses having 12-percent transmission, polarizing, neutral filters (Sun, N-1, Contract No. NXsX-66884). One was a field study of 20 members of four seaplane beaching crews.[10] The other was a laboratory study made on a group of three men attached to the Dispensary, NAS, Pensacola.[11]

Field study. The men from the seaplane squadron (Squadron 8-A) were selected because they had been working on the seaplane ramps for a number of months and had been exposed to sunlight from six to eight hours per day during this period. With such subjects it was possible to determine the protection to night vision afforded by wearing low-transmission sunglasses under operating conditions at a Naval Air Station.

After preliminary threshold measurements, the 20 men were divided into two groups. One group was issued glasses and the other was not. The men with the glasses were instructed to wear them at all times while they were out-of-doors. The remaining men carried on their work as usual and thus acted as a control group. The experimental conditions for the two groups were reversed on the fifteenth day of the experiment.

There was a negligible difference between the two groups during the preliminary tests. However, when one group wore the glasses there was a consistent

threshold difference between the two groups, favoring those who were protected. As table 2 shows, the differences in the afternoon thresholds were 0.21 log μμ lamberts after 30 minutes of dark adaptation and 0.22 log μμ lamberts after 60 minutes of dark adaptation. These thresholds were taken after approximately three hours' exposure to sunlight. As in the previous experiment, the morning data show similar but smaller differences (fig. 3). The average differences in these morning thresholds were 0.17 log μμ lamberts after 30 minutes and 0.15 log μμ lamberts after 60 minutes of dark adaptation (table 2). Due to inclement weather at the time the groups were reversed, the data at this point are somewhat obscure, but there was a trend toward a reversal of the thresholds of the groups. The final point on the curve (fig. 3) is the average from the 18th and 20th days.

TABLE 2

AVERAGE THRESHOLDS OF EXPOSED GROUP AND SUNGLASS GROUP

	Mean Morning Thresholds in Log μμ Lamberts		Mean Afternoon Thresholds in Log μμ Lamberts	
	Dark-Adaptation Times		Dark-Adaptation Times	
	30 min.	60 min.	30 min.	60 min.
Exposed group	2.88	2.76	2.97	2.83
Sunglass group	2.71	2.61	2.76	2.61
Average difference	0.17	0.15	0.21	0.22

The data indicate that the low-transmission sunglasses used in this experiment afford excellent protection to the retinal sensitivity of persons working in

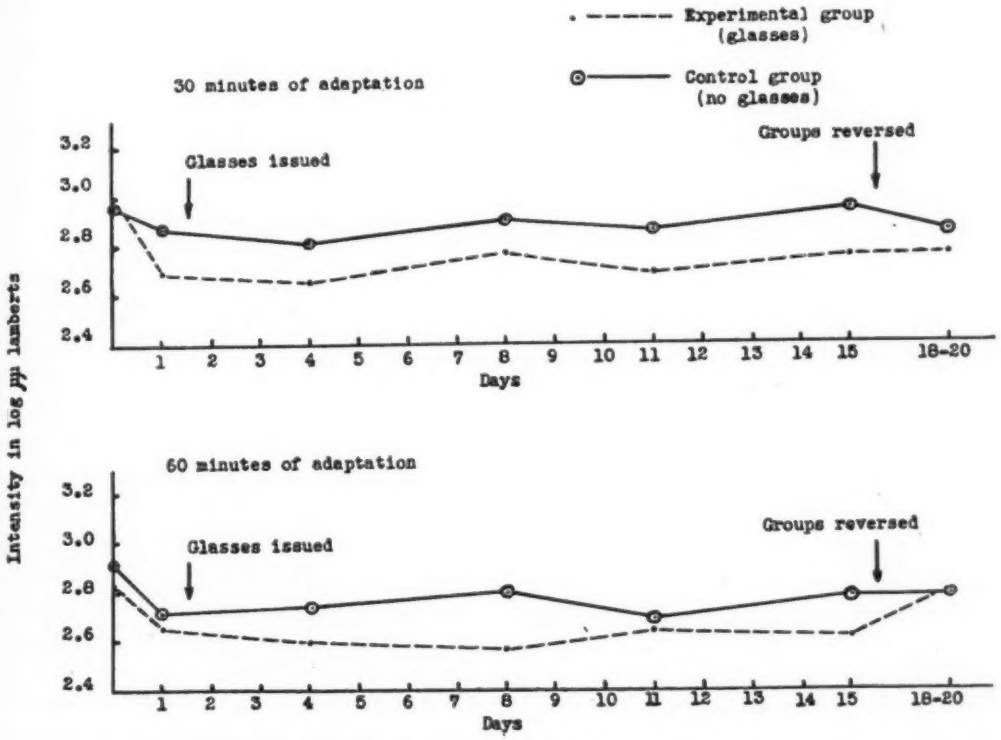


Fig. 3 (Clark, Johnson, and Dreher). Morning dark-adapted thresholds.

sunlight for prolonged periods. The protection is sufficient to result in higher visual efficiency of practical importance to those engaged in visual tasks at night.

Laboratory study. In a more carefully controlled experiment, a group of three men was studied with the same technique as that employed when the eye shield was used. Here, however, a 12-percent polarizing neutral filter was worn over one eye instead of an eye patch. The exposure to sunlight varied between three and fours hours per day.

The results followed the same pattern found with the eye patch. When the subjects were exposed to sunlight for extended periods, there was an immediate and marked elevation in the threshold of the unprotected eye as compared with the protected eye (fig. 4). After 30 minutes of dark adaptation this amounted to 0.24 log μμ lamberts and after 60 minutes to 0.19 log μμ lamberts (table 3). This higher threshold persisted overnight and amounted to 0.13 log μμ lamberts after both 30 and 60 minutes of dark adaptation in the morning tests (fig. 5, table 3). When the filter was changed to the left eye, there was an immediate reversal of sensitivity in the two eyes. Here again, as

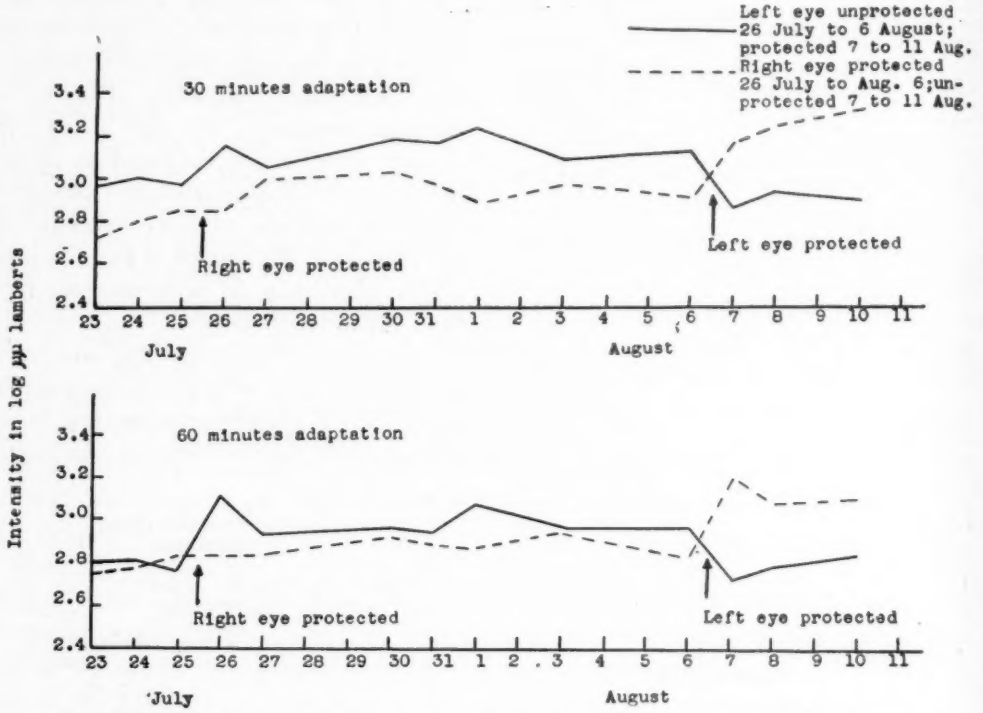


Fig. 4 (Clark, Johnson, and Dreher). Afternoon dark-adapted thresholds. N = 3.

TABLE 3

AVERAGE THRESHOLDS OF EXPOSED EYES AND EYES PROTECTED WITH SUNGLASSES

	Mean Morning Thresholds in Log μμ Lamberts		Mean Afternoon Thresholds in Log μμ Lamberts	
	Dark-Adaptation Times		Dark-Adaptation Times	
	30 min.	60 min.	30 min.	60 min.
Exposed eye	3.05	3.03	3.17	3.04
Protected eye	2.92	2.90	2.93	2.85
Average difference	0.13	0.13	0.24	0.19

in the eye-shield study, the immediacy of the reversal in threshold sensitivity following reversal of the experimental conditions indicates that the threshold elevation in the exposed eye was only temporary.

These results show clearly that the sunglasses used in this experiment are effective in providing protection of the retinal sensitivity of persons exposed to sunlight for prolonged periods. They also indicate that the 30-minute period of dark adaptation generally required for obtaining a practical maximum of night visual efficiency is inadequate for persons who have been directly exposed to sunlight for extended periods through the day.

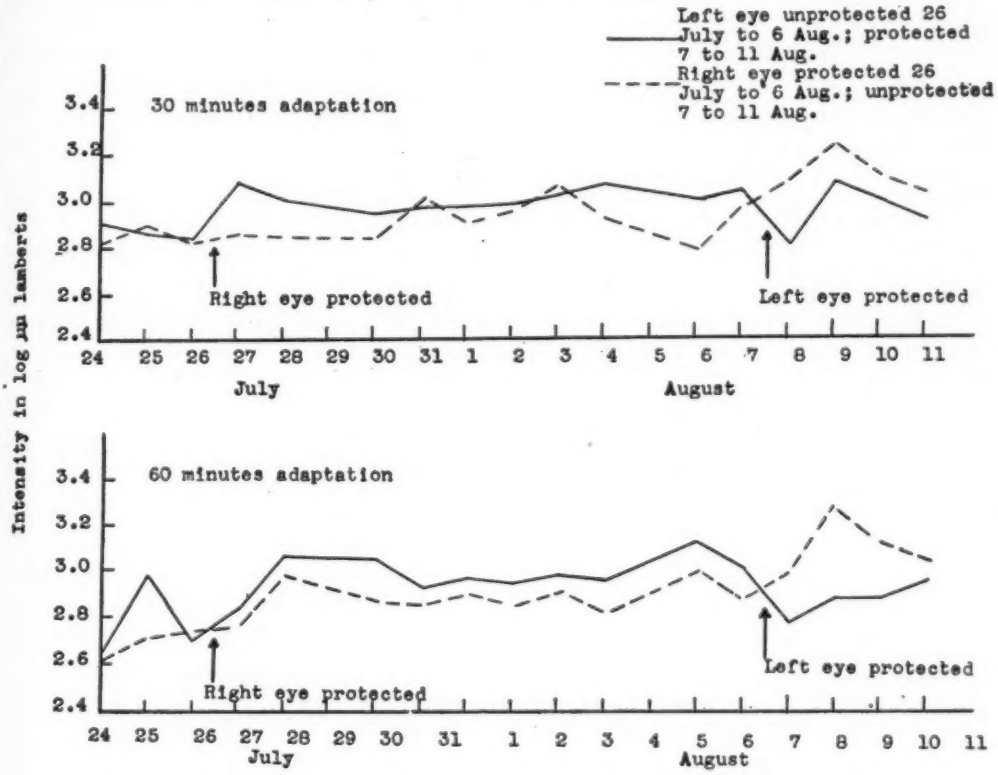


Fig. 5 (Clark, Johnson, and Dreher). Morning dark-adapted threshold. N = 3.

Summary

Individuals exposed to sunlight for three to four hours a day over a period of two weeks show a marked elevation of the night visual threshold immediately following exposure. The degree of elevation persisting overnight is sufficient to cause approximately a 50-percent loss in night visual efficiency. Furthermore, it appears that persons exposed to sunlight for extended periods daily, without protection to their eyes, require in excess of one hour of adaptation to achieve a practical maximum of night visual efficiency. Exposure to brilliant sunlight has been reported as the cause of night blindness that is more or less permanent. However, the present studies on normal individuals indicate that the effects of daily exposure for three to four hours are only temporary, since the threshold returns to normal after one day's protection from the sun.

Persons wearing 12-percent transmis-

sion polarizing sunglasses during prolonged exposure to sunlight had significantly lower night-visual thresholds than those who did not. In view of these results, personnel engaging in night duties requiring a high degree of night visual efficiency at starlight intensities should be provided with low-transmission sunglasses to be worn during any daytime activities which expose them to excessive sunlight.

Bibliography

[1] Duke-Elder, W. S. Text-book of ophthalmology. Ed. 2, St. Louis, C. V. Mosby Co., 1940, v. 1, p. 984.

[2] Derman, H. Nachtblindheit durch Lichtwirkung. Schweiz. Med. Woch., 1943, v. 24, p. 98. Cited from Hecht et al.[8]

[3] Livingston, P. C. The study of glare in Iraq. Brit. Jour. Ophth., 1932, v. 26, pp. 577-625.

[4] McCartney, J. L. Tropical neuropsychiatry. War Medicine, 1943, v. 3, p. 351.

[5] Haig, C. The course of rod dark adaptation as influenced by the intensity and duration of pre-adaptation to light. Jour. Gen. Physiol., 1941, v. 24, p. 735.

[6] Hecht, S., Haig, C., and Chase, A. M. The influence of light adaptation on subsequent dark adaptation of the eye. Jour. Gen. Physiol., 1937, v. 20, p. 831.

[7] Winsor, C. P., and Clark, A. B. Dark adaptation after varying degrees of light adaptation. Proc. Nat. Acad. Sci., 1936, v. 22, p. 400.

[8] Hecht, S., Hendley, C. D., Ross, S., and Richmond, P. The influence of exposure to intense sunlight on subsequent night vision. Bur. Med., Res. Project #X-442(Av-233-W), April 26, 1945.

[9] Clark, B., Johnson, M. L., and Dreher, R. E. The effect of excessive sunlight on the retinal sensitivity of an unprotected and a completely protected eye in the same individual. Bur. Med., Res. Project #X-567(Av-295-p), Report No. 1, Aug. 11, 1945.

[10] Clark, B., Johnson, M. L., and Dreher, R. E. A study of the effectiveness of sunglasses in the protection of night vision. Bur. Med., Res. Project #X-561(Av-290-p), Report No. 1. Sept. 7, 1945.

[11] Clark, B., Johnson, M. L., and Dreher, R. E. The protection to night vision afforded by sunglasses. Bur. Med., Res. Project #X-567 (Av-295-p), Report No. 2, Oct. 18, 1945.

OBSERVATIONS ON THE VOSSIUS RING*

TRYGVE GUNDERSEN, MAJOR (MC), A.U.S.
Washington, D.C.

Vossius ring is the eponymic term for a well-known ring occasionally seen on the anterior capsule of the crystalline lens of only young individuals, following trauma. Various writers have used other terms for it, usually to indicate its cause or appearance; such as, contusion ring, traumatic annular opacity, ring deposit.

Vossius first described this now-famous ring in 1903 and made a more comprehensive report on the subject before the International Congress of Ophthalmology, at Lisbon, in 1906. He distinguished two forms, a colored one which he said came from the pars ciliaris iridis, and a colorless one which he attributed to degenerative changes in the lens-capsule epithelium and possibly in the anterior cortical layers of the lens. The latter, he said, was more rare than the former.† Vossius ascribed the ring to an opacity in the capsule and possibly in the underlying anterior cortex of the lens, presumably caused by the impact of the iris against these tissues. Even in his last paper on this subject, in 1908, he held the same opinion.

The original theory of Vossius implied that the cornea was actually indented so that its posterior surface came in direct contact with, and forced the iris border against, the lens. The possibility that this could happen was promptly denied by many observers. Hoeg (1909) contested it on four grounds: the ring was almost always complete, it was regular in form, the inner border was no denser than the outer, and, finally, the object causing the contusion would need to be of about the same size in all cases. He therefore suggested that a momentary rise in ocular pressure was sufficient to effect the same result. Steiner (1910) and shortly thereafter Purtscher (1913) described cases in which the injury had been *vis a tergo*, that is, by penetrating wounds of the posterior orbit. The corneas had suffered no direct trauma whatever. Few writers held to the old Vossius explanation after Hoeg's objections. Notable among them were Klauber (1918), Behman (1920), and Urbanek (1923).

Not until 1918 did Hesse and, shortly thereafter, Vogt show that the ring was not an opacity in the lens or lens capsule, but a thin ring of deposit on the former.

Severe trauma and intraocular hemor rhage are the two most constant factors. Vogt states that a Vossius ring has never followed nontraumatic hyphemia, and he believes the instance which Hesse reported, wherein a ring followed a vitreous hemorrhage twice punctured surgically, to be an "iritis ring."‡ Hesse, who believes that the hemorrhage is more important than the trauma, brings forth the following evidence to support his views. He cites two cases in which the ring was seen following anterior-chamber hemorrhage, in which the trauma was insignificant; also Zentmayer's case, confirmed by

* From the Surgical Consultants' Division, Ophthalmology Branch, Office of the Surgeon General. Read before the eighty-first annual meeting of the American Ophthalmological Society, at Hot Springs, Virginia, November, 1945.

† Although I have never seen the colorless transparent form, E. Cramer gives an excellent example of one.

‡ In his "Atlas of slit-lamp microscopy" he illustrates the difference, pointing out that the iritis ring is broader, its individual dots larger and more irregular in size, and also that free pigment dots appear on the capsule about the periphery of the ring.

Holloway, wherein a ring appeared after an anterior-chamber hemorrhage which followed an advancement operation. The iridic vessels were inadvertently injured by the needle penetrating, or possibly perforating, the sclera.

The period of time between the contusion and the appearance of the ring would seem to answer the question as to whether it was composed of iridic elements left behind on the lens when the two tissues were forcibly compressed against each other, or whether the ring was blood corpuscles or other blood elements secondarily deposited from intraocular blood, especially blood from the anterior chamber. The fact that no one has ever reported seeing a ring immediately after injury seems to prove there was none to observe. The shortest interval between the injury and discovery of a ring was two hours (Urbanek's case). In the great majority of cases the ring was not discovered until approximately four days after injury. It is claimed that delay in discovery is due to hindrances to examination—often the injury is immediately followed by bleeding in the anterior chamber or clouding of the cornea, either of which may obscure the picture. Or, more often, pain, irritation, and swelling of the lids make an accurate examination impossible. These reasons could account for the interval before discovery in most cases, but not all. If trauma were the direct cause, there would be at least a few cases in which the ring was observed immediately.

No instance of a ring has been observed in the absence of visible intraocular blood, or where the possibility of preexisting intraocular blood has been excluded. Hesse is doubtless the first and strongest exponent of the hematogenous theory of origin. He points out that in certain instances a complete disc is deposited over the anterior lens capsule, the center of which first becomes absorbed, hence leaving a ring. Caspar previously described such a case, wherein only after the coagulum overlying the capsule had become absorbed, did the complete ring appear. Peters, too, contends that the deposit is blood pigment rather than iridic pigment. He furthermore draws an analogy between it and hematogenous pigmentation of the cornea, and finds a similarity between the fine brown granules in the Vossius ring and the "fibrin crystals" which Leber described in the hematogenously pigmented cornea. The relatively short period of time occurring between the contusion and the appearance of the ring is the strongest argument against the similarity of these two deposits.

Exactly how a sudden rise in ocular pressure could cause pigmented particles from the iris to become fastened to the smooth lens capsule is not clear. Presumably, the rise in hydrostatic pressure in some manner would squeeze the iris tissue with sufficient force to cause interstitial fluids containing pigment granules and protein to leave the iris and become fastened to the capsule by fibrin. This is the so-called "abklatsch theory" which has the greatest number of supporters, notably Vogt, A. Jess, and others. A supplement to this idea was proposed by O'Asaro Biondo, who suggested that the lack of hydrostatic equality between lens and iris was an important factor. The inertia of lens being greater than that of iris caused sudden contact between them when the pressure wave traveled through the ocular media.

Handmann contributed a notable paper on Vossius rings in 1930, and carefully reviewed the literature to that date. He strongly supported the hematogenous theory of origin, but denied that contusion was invariably necessary. He likewise pointed out the similarity in size of

the rings which he had seen and those previously reported in the literature. On the basis of these observations he denied that the iris had anything to do with the pathogenesis and proposed a new theory of origin. He cited the detailed work of Busacca and Melli on the anatomy of the lens capsule; especially that the zonular lamellae, after fanning out over the equatorial surface, completely disappeared in just the area occupied and enclosed by the Vossius ring. Presumably, according to Handmann, the osmotic interchange of metabolites occurs in this area, where the capsule is devoid of one membranous layer, and it was not surprising to him that blood derivatives became fixed to the capsule, and indeed in the capsular pores at this point. The fact that the senile lens is immune to this process was explained by its decreased porosity. Handmann further speculated on the effect of the temporary stoppage or slowing down of the aqueous convexion currents which often follow trauma. His interpretation was that the stagnation favored the deposition of blood or blood pigments on the capsule. Questions which were left without answer were, why Vossius ring so rarely, if ever, follows nontraumatic hyphemia; why it is always seen in its regressive and never in its formative stage; and what effect contusion has in initiating the process?

A single histologic examination might prove whether the particles deposited on the lens capsule were fuchsin bodies from the pupillary pigment epithelium or blood elements, but not to my knowledge has such an examination ever been made.

My interest in this subject was first stimulated when I observed that four soldiers, simultaneously in the hospital for contusions and penetrating wounds of the orbit, had Vossius rings of the same size. This seemed particularly interesting since their injuries had occurred during the day, in two instances, and in the other two instances, during the night. The imprint of the pupillary margin on the anterior lens capsule should occur instantaneously at the moment of contusion and hence record either a contracted or dilated pupil. As more Vossius rings were seen in new patients, this uniformity in size was confirmed in every one. It first seemed possible that the pupil might have contracted following the light-flash stimulation, before contusion occurred, but since this pupillary light reflex is slow—0.2 to 0.5 seconds—and the blast wave very fast—12,000 ft. per second—it was obvious that this could not have happened. Even shell fragments which scatter at 6,000 ft. per second, striking the eye, would precede the pupillary reflex. Another pupillary reflex, that due to direct pressure on the globe, may also be considered here. Von Berlin and Gaille have described it, but to my knowledge its speed has not been measured.

Personal observations

During 10 months, 19 Vossius rings were seen in 15 patients; that is, four of these had bilateral rings. They all occurred in young American soldiers 19 to 30 years of age. All had been wounded in battle, six by mines, eight by shell or grenade fragments, and one by a rifle bullet. Contusion of the globe without perforation accounted for 13. Eight of these had multiple penetrating wounds of the cornea with retained foreign bodies in addition to contusion. There were three patients with intraocular foreign bodies; two had been removed before the Vossius ring was seen, and the third had multiple foreign bodies visible on the iris.

Intraocular hemorrhage was present in every eye. Thirteen showed blood in the vitreous. Except for the last two patients listed, who had massive vitreous hemorrhages and who had had intraocular

foreign bodies extracted by the posterior route, the vitreous hemorrhages were localized and circumscribed near the retina and usually in the far periphery. Hyphemia was seen in only two eyes, but

A transparent millimeter ruler was held as closely to the cornea as possible without actually touching it. The diameter was then measured as seen through a convex lens of an ophthalmoscope (+8.00D. sph.)

TABLE 1

DATA ON THE OCCURRENCE OF VOSSIUS RING IN 19 EYES OF 15 SOLDIERS

Case No.	Age	Hour Injured	Diameter of Vossius Ring	Cause	Nature of Eye Injury	Vision	Tension (Schiøtz)	Days Between Injury and Vossius Ring
1	20	2300	R. — L. 2.50	Bullet	R. Avulsion L. Contusion–vit. & ret. hem.	R. nil L. 1/200	— —	4
2	29	1350	R. 2.50 L. —	Mine	R. Contusion–vit. & ret. hem. L. Perf. wd., iridodial., bull. ker.	R. 20/30 L. 2/200	— —	5
3	30		R. 2.25 L. —	Shell	R. Pen. wds.–F.B.'s, vit. & ret. hem. L. Perf. wd., phthisis bulbi	R. 4/200 L. L.	— —	19
4	19	0100	R. 2.50 L. 2.50	Mine	R. Pen. wds.–F.B.'s L. Pen. wds.–F.B.'s, vit. hem.	R. 20/50 L. 20/50	— —	3
5	20	1400	R. — L. 2.50	Shell	R. None L. Contusion–vit. & ret. hem., hole macula	R. 20/20 L. 25/00	R. 13 L. 8	4
6	19	1300	R. 2.75 L. —	Shell	R. Contusion–vit. hem. L. None	R. 20/70 L. 20/30	R. 13 L. 13	4
7		0200	R. — L. 2.00	Mine	R. Pen. wds.–cor.–F.B.'s L. Perf. wds.–i.o.F.B.'s.–iris–vit. & ret. hem.	R. 20/30 L. 20/40	R. 9 L. 8	8
8	20	1730	R. 2.50 L. —	Shell	R. Contusion–bull. ker–vit. hem. L. None	R. 20/400 L. 20/20	— —	4
9	22	1030	R. 2.50 L. 2.60	Mine	R. Contusion–hyphemia, vit. hem.–F.B.'s L. Pen. wds.–cornea–contusion–few aq. cells	R. 20/100 L. 20/50	R. 11 L. 10	3
10	20	0600	R. 2.75 L. —	Mine	R. Contusion–large orb.–F.B.–i.o.F.B. L. None	R. 20/900 L. —	— —	— —
11	21	0300	R. 2.25 L. —	Grenade	R. Contusion–hyphemia–ret. & vit. hem. L. None	R. 20/200 L. 20/70	— —	4
12	25	0400	R. 2.60 L. 2.50	Mine	R. Contusion–pen. wds. & F.B.'s.–cells in a.c. L. Contusion–pen. wds. cor. & F.B.'s.–cells in a.c.	R. 20/50 L. 20/70	R. 15 L. 18	4
13		1430	R. 2.50 L. 2.50	Shell	R. Contusion–rupture iris–sphincter–pen. wds. with F.B.'s cor.–vit. hem. L. Contusion–pen. wds. cor.–F.B.'s.	R. — L. —	— —	17
14	23	1130	R. 2.50 L. —	Grenade	R. Perf. wd.–i.o.F.B. (large), vit. hem. after F.B. extraction L. None —	R. L.P. L. —	— —	25
15	20	1700	R. 2.60 L. —	Shell	R. Perf. wd. & i.o.F.B. post. extraction L. None —	R. L.P. L. —	— —	12

was doubtless present in many others before the patients came to the hospital. In only four eyes was it impossible to find extensive retinal or vitreous hemorrhage. These eyes did have cellular elements visible in the aqueous on slitlamp examination, doubtless blood cells.

The size of 19 contusion rings varied between 2.25 and 2.75 mm. as measured by the following relatively crude method: without making any correction for its magnification by the cornea. The width of the band forming the ring could not be measured by this method. On correlating this uniform diameter of the ring with the size of the pupil at the time of injury, the following analysis is interesting: Eight injuries occurred during daylight hours, five during darkness, and one at twilight. It is therefore clear that the size of the

Vossius ring bears no relation to the size of the pupil before injury occurred.

Certain other physical characteristics of the ring are worthy of mention, and one in particular constitutes strong evidence against the theory that it is an impression of the pupillary margin on the anterior lens capsule. The ring is composed of fine brown dots arranged in an evenly distributed pattern. Its outer border is perfectly smooth, but its inner border, which is the nearer to the smooth free iris border, is distinctly irregular. Groups or clusters of particles extend toward the center of the pupil in a manner which gives this margin a scalloped or even saw-toothed appearance with the slitlamp. If the Vossius ring were an imprint of the pupillary margin, one would expect that the inner border of the imprint, corresponding to the free iris margin, would be smooth, whereas the outer might or might not be. That the reverse is true is additional strong evidence that the iris margin is not imprinted on the lens capsule. The smooth outer border is more likely to be so delimited for some other reason; such as, an abrupt anatomic change in the lens capsule at the equatorial region.

Observations on conditions allied to Vossius ring

It is desired at this time to draw attention to a condition I have observed in two patients which I believe is pathogenically related to the Vossius-ring phenomenon.

The first patient was a soldier, aged 20 years, with sympathetic uveitis. He was first seen by me 11 weeks after a shell fragment had perforated his left eye and 5 weeks after the onset of uveitis in his right eye. His right eye had been atropinized since he first noticed blurring of vision, and the pupil had been well dilated at all times. Vision was 20/50. The injured eye had been removed two weeks after sympathetic ophthalmia began, and on pathologic examination showed inflammation consistent with sympathetic uveitis. The sympathizing eye was slightly congested. There were keratitic precipitates covering almost the entire posterior surface of the cornea, increasing in number and size over the lower half in characteristic fashion. Similar precipitates also covered the anterior lens capsule. These were generally more uniform in size and distribution than those on the cornea. The important observation was that within a perfect circle, measuring 2.75 mm. in diameter on the center of the anterior lens capsule, there was a distinct area of clearing of the precipitates. Although not absent altogether, they were smaller in size and more sparsely distributed. The clear disc was best seen when viewed through the ophthalmoscope.

The patient was again seen nine weeks later. The disc of clearing was still perfectly obvious, although less well demarcated.

When observed through the slitlamp, this particular portion of the lens capsule appeared to be covered with a delicate lacelike film with knots comprising the precipitates. The latter were not invariably joined together but usually had several spicules extending toward their neighbors. No spicules extended into the anterior chamber. The precipitates themselves were gray and faintly pigmented. There were many fine cellular elements circulating in the aqueous, but no Koeppe nodules could be seen on the iris margin.

Since describing this finding to Dr. David G. Cogan, four months ago, he has told me that he too has observed this clear disc on the anterior lens capsule of a patient with chronic uveitis. Although its actual diameter was not meas-

ured, he, in retrospect, estimated it to be about 2 to 3 mm.

Discussion

As can be seen in the foregoing narrative about Vossius rings, much has been written about them. These writings are found almost entirely in the foreign literature. The subject as a whole does not seem to have stimulated much interest either in America or in England. In fact, I have yet to find an American ophthalmologist who has entertained any other theory of origin than that originally proposed by Vossius.

Although there is still much to be learned about the conditions, it seems wise at this time to assemble the knowledge gained from the important contributions cited, add to them observations which I myself have made, and finally sort out the factual from the fanciful ones.

The following facts seem clearly established:

Vossius ring is almost without exception the result of trauma. Zentmayer's patient, who certainly had a minimal amount of trauma, did have a tiny perforating wound and in addition the surgical trauma attending any advancement operation. Hesse, who has been the strongest exponent of the hematogenous theory of origin, stresses the importance of intraocular blood, at the same time minimizing the importance of trauma. In two of his cases he mentions that they had no "significant" trauma but does not say they had none whatever. I believe, therefore, that the existence of a nontraumatic Vossius ring has never been proved.

Intraocular hemorrhage is also a wholly constant finding. It was present in each of my 19 cases and in no reported case has its presence been excluded. Blood may be found either in the retina, vitreous, or aqueous. Often it is found in two or all three of these structures. That intraocular hemorrhage is such a constant factor is strong presumptive evidence that it plays an etiologic role.

Senile and presenile eyes seem to be immune to Vossius-ring formation. So far as I know, a ring has never been recorded in the eye of a patient after the beginning of the fifth decade.

Vossius rings have been seen only in the regressive and never in the formative stage. This is a significant fact, and until the formative stage has been observed it constitutes the weakest link in the hematogenous theory of origin and a strong argument for the "abklatsch theory." In my opinion it is likely that some day a ring will be seen to form, since other evidence points so strongly to the idea that they are composed of blood pigments. The fact that they have not to this day been observed in their developmental stage may be explained by their rarity, the difficulty in adequately examining a freshly injured eye, the fact that hyphemia so often obscures the lens capsule and, probably more important, that they escape our notice until completely formed. We see only that for which we are searching.

Vossius rings have never been observed immediately after injury. As previously mentioned, two hours is the earliest interval between injury and observation. This time interval does not exclude the possibility that iridic pigment may have been deposited at the time of contusion, but it is evidence against it. If the ring be of blood pigments, or blood derivatives, two hours seems an incredibly short period of time for them to be deposited. However, the vast majority are seen days after injury, and since errors in observation are always

possible, the common prolonged latent period is probably more significant.

The constant size of Vossius rings has now been established. In the 19 cases reported, the variations in diameter did not exceed one-half millimeter, and in every reported case, where measurements have been recorded, the size is practically identical with those I have reported. As previously pointed out, this in itself practically excludes the possibility that the iris margin has left its imprint on the lens capsule.

Finally, a characteristic which I believe is constant is the smoothness of the outer border and irregularity of the inner border of the Vossius ring. This is further strong evidence against the "abklatsch theory" of origin.

The following questions remain without answer or are purely in the realm of speculation: If the ring is not caused by an impression of the iris margin, what is its cause? What are the fine brown granular deposits which one sees with the slitlamp? Why is the ring of constant size? Why is trauma a necessary factor, or why does the ring never follow nontraumatic hyphemia? Finally the question arises—What is the relationship between the Vossius ring and the disc of clearing which I have described in uveitis?

Handmann has thrown considerable light on these questions. Since the lens capsule loses its zonular lamella somewhere in this region, one might assume that it occurred exactly at the outer margin of the Vossius ring. This would account for its regular size, and since the theory accepts the hematogenous origin, it would follow that the brown deposits are blood pigments. The greater interchange of fluids between aqueous and lens through this thinner area of the capsule reasonably explains the deposition of a disc of blood pigment within this circle. It seems to me it also explains the relative clearing of these and other deposits in the central area. But the fact that a ring is the rule and a disc is the exception, cannot be satisfactorily explained with our present knowledge. It may be that the circulation in the anterior chamber is temporarily abolished as suggested by Handmann, but this must also occur in some cases of spontaneous hemorrhage. In my opinion trauma must have some other effect. An explanation of this important point awaits further elucidation.

Concluions

1. Nineteen cases of Vossius-ring formation are reported.

2. All occurred as a result of battle injury in American soldiers between the ages of 19 and 30 years.

3. Intraocular hemorrhage was found in every eye.

4. The size of the ring was practically constant in all cases—2.25 to 2.75 mm. were the limits of variation in their diameters.

5. It is concluded that the ring does not consist of iris pigment left behind on the lens capsule as a result of the injury.

6. The most tenable explanation for the formation of the Vossius ring is that blood pigments from the aqueous are deposited in characteristic fashion during the interchange of fluids through the anterior lens capsule.

7. A disc of clearing is described on the anterior lens capsule in a case of uveitis. This is thought to indicate that interchange of fluids through the anterior lens capsule takes place chiefly here.

101 Bay State Road,
Boston 15, Massachusetts

Bibliography

Alajamo, B. Boll. d'Ocul., 1924, p. 531.
Bäck, S. Arch. f. Ophth., 1899, v. 47, p. 82.
Behmann, A. Klin. M. f. Augenh., 1920, v. 64, p. 255.
Biondo, M. d'A. Rassegna Ital. d'Ottal., 1932, v. 1, pp. 503-531.
Busacca, A., and Melli, G. Klin. M. f. Augenh., 1928, v. 80, p. 308;
Busacca, A. Klin. M. f. Augenh., 1929, v. 83, p. 737.
Caspar, L. Klin. M. f. Augenh., 1907, v. 45, II, p. 425; 1909, v. 47, p. 606.
Chaillous and Polack. Compt. rend. Soc. d'Opht. de Paris, Seance 6, 1906, III.
———. Ann. d'Ocul., 1906, v. 135, p. 318.
———. Klin. M. f. Augenh., 1906, v. 44, p. 428.
Coats, G. Ophth. Rev., 1912, v. 31, p. 295.
Cogan, D. G. Personal communication.
Colombo, G. L. Arch. di Ottal., 1920, v. 27, pp. 173-186.
Corrado, A. Rinasc. Med., 1925, v. 11, p. 1.
De Rothschild, H. Rev. Gén. d'Opht., 1896, v. 14, p. 31.
Dujardin. Jour. Sci. Méd. de Lille, 1888, p. 372.
Durr, S. Amer. Jour. Ophth., 1926, v. 9, p. 436.
Finnoff, W. C., and O'Rourke, D. H. Amer. Jour. Ophth., 1925, v. 8, p. 561.
Gifford, H. Ophthalmology, 1909, v. 5, p. 228.
———. Ophth. Rec., 1910, v. 19, p. 412.
Gipner, J. F. Trans. Amer. Ophth. Soc., 1929, v. 27, p. 296.
Graefe-Saemisch. Handbuch der gesamten Augenheilkunde. Ed. 2, Leipzig, W. Engelmann, 1901-11, v. 9, pt. 5.
Handmann, M. Klin. M. f. Augenh., 1930, v. 85, Supplement, p. 79.
Hescheler, J. Klin. M. f. Augenh., 1910, v. 48, p. 443.
Hesse, R. Zeit. f. Augenh., 1919, v. 39, p. 195; 1919, v. 41, p. 226; 1921, v. 46, p. 125; 1925, v. 54, p. 353.
———. Klin. M. f. Augenh., 1931, v. 87, p. 55.
Higashi, T. Acta Soc. Ophth. jap., 1930, v. 34, Festschr. Ichikawa, p. 258.
Hoeg, N. Klin. M. f. Augenh., 1909, v. 47, p. 593.
Holloway, T. B. Proc. College of Physicians of Philadelphia, 1912, v. 2, p. 15.
———. Klin. M. f. Augenh., 1913, v. 51, p. 118.
Imai, S. Zeit. f. Augenh., 1909, v. 22, p. 126.
Jess, A. In Schieck and Brückner's "Kurzes Handbuch der Augenheilkunde." Berlin, Julius Springer, 1931, v. 4.
Keller, Inaug. Diss., Giessen, 1906.
Klauber, E. Klin. M. f. Augenh., 1918, v. 60, p. 764; v. 60, p. 504; 1918, v. 61, p. 180.
Kramer, E. In Schieck and Brückner's "Kurzes Handbuch der Augenheilkunde," Berlin, Julius Springer, 1931, v. 4.
Kraupa, E. Klin. M. f. Augenh., 1922, v. 68, p. 774.
Krusius, F. F. Zeit. f. Augenh., 1907, v. 17, pp. 522-524.
Lampert, P. Arch. d'Opht., 1921, v. 39, pp. 745-749.
Leber. Arch. f. Ophth., 1889, v. 35, pt. 1, pp. 271-277; pt. 2, pp. 250-256.
Löhlein, W. Zeit. f. Augenh., 1908, v. 20, p. 264.
Merz, A. Woch. f. Therap. u. Hyg. d. Auges, 1906-7, v. 10, p. 73.
Natanson, A. Klin. M. f. Augenh., 1908, v. 46, pp. 537-539.
Nicolai. Arch. f. Augenh., 1910, v. 57, p. 243.
Peters. Klin. M. f. Augenh., 1925, v. 75, p. 74.
Purtscher, O. Centralbl. f. prakt. Augenh., 1913, v. 37, pp. 1-8.
Schirmer, O. Inaug. Diss., Greifswald, 1887.
———. Arch. f. Ophth., 1888, v. 36, p. 131.
———. Klin. M. f. Augenh., 1890, v. 28, p. 161.
Schurmann, R. Klin. M. f. Augenh., 1920, v. 64, p. 807.
Steiner, L. Klin. M. f. Augenh., 1910, v. 48, p. 60.
Stoljar, M. Festschr. f. Prof. Awerbach, Moskau, 1926, p. 170.
Tacke. Bull. Soc. Belge d'Opht., 1905, v. 17, p. 21.
Terson, A. Compt. rend. Soc. d'Opht. de Paris, Seance 6. 1906, III. Abst., Ann. d'Ocul., 1906, v. 135, p. 319.
Triebenstein. Klin. M. f. Augenh., 1919, v. 63, p. 145.
Urbanek, J. Zeit. f. Augenh., 1923, v. 50, p. 159.

Vano, H., and Terasimo, H. Chuo Ganko Iko, 19, v. 32, pp. 1-6.
Vogt, A. Zeit. f. Augenh., 1918, v. 40, p. 204.
———. Arch. f. Ophth., 1922, v. 109, p. 154.
Vossius, A. Med. Gesellsch., Giessen, 1903. Abst., Deutsche Med. Woch., 1904, p. 189.
———. Enziklopädia der Augenh., 1905, v. 12, p. 523.
———. Klin. M. f. Augenh., 1906, v. 44, p. 544.
———. Lehrbuch der Augenheilkunde, 1908, v. 4, p. 872.
Wagenmann, A. In Graefe-Saemisch "Handbuch der gesamten Augenheilkunde." Ed. 2, Leipzig, W. Engelmann, 1910, v. 9, p. 463.
Wagner. Klin. M. f. Augenh., 1869.
Zentmayer, W. Amer. Jour. Ophth., 1924, v. 7, p. 676.
Zimmermann, C. Ophthalmology, 1915, v. 11, p. 327.

SACCULAR PROLAPSE OF THE VITREOUS BODY*

Report of case

Ralph A. Poirier, M.D.
Rochester, Minnesota

Hernias of the vitreous body into the anterior chamber of the eye may be classified into three groups according to Paula-Santos:[1] (1) hernias following intracapsular extraction of cataracts; (2) hernias following the rupture of the vitreous body after discission of the lens or an aftercataract; and (3) hernias following displacement of the lens into the anterior chamber. In the first group the vitreous body remains intact and the hernia usually occurs as a symmetrical protrusion into the anterior chamber. After several days the hernia may recede to normal position. In the third group hernias occur after rupture or partial disinsertion of the zonule. This group includes congenital, surgical, and traumatic displacements of the lens.

Hernias resulting from traumatic displacement of the lens may have two distinct forms: (1) no definite anterior limiting membrane; (2) a distinct anterior limiting membrane covering the vitreous which is in the form of a sac or a drop. This saccular form is extremely rare. Blood may be placed in the dependent portion of the sac and almost without exception pigment is deposited on the anterior limiting membrane in a kaleidoscopic fashion. The anterior limiting membrane may appear as a single layer or it may appear to be laminated. Duke-Elder[2] stated that this distinct anterior membrane is probably a mechanical effect of the tension and stress created by the prolapse on the micellar structure of the vitreous causing a rearrangement, a reorientation, and a condensation of its fibrillar contents. Cowan and Fry[3] offered anatomic and histologic evidence that a hyaloid membrane existed as a nonnuclear, structureless, uniformly staining membrane. This membrane was attached to the pars plana of the ciliary body and separated the aqueous from the vitreous chamber. Previously Cowan[4] stated that the membrane might be a proliferation of the vitreous surface but not a condensation.

Report of case

The patient, a white man, came to the

---

* Fellow in Ophthalmology, The Mayo Foundation.

Mayo Clinic on July 2, 1945. The right eye had been injured by a football in 1918, at which time he had partial loss of vision. In 1929 he noticed that the right eye was divergent and that its vision was limited to perception of moving objects. On June 9, 1945, the right eye became extremely painful and red. He consulted an ophthalmologist and was informed that a cataractous lens was dislocated into the anterior chamber and was causing irritation. He was given atropine to use twice daily. The eye remained red but the pain gradually subsided. However, on June 27th, the eye again became extremely painful. His physician, at this time, advised an operation to reduce the intraocular pressure. He consulted another ophthalmologist shortly thereafter and was told the pressure was normal.

Examination at the Clinic revealed visual acuity of 1/60 in the right eye and 6/6 in the left eye. The right eye was 30 degrees divergent. Pupillary reflexes were absent in the right eye but were prompt in the left eye. Further examination of the left eye revealed no abnormalities, so the following comments pertain only to the right eye. The eye was free from inflammation except slight circumcorneal injection. The iris was tremulous and remnants of the lens capsule were discernible in the anterior chamber. The fundus was seen poorly but appeared normal. Biomicroscopy revealed that the cornea was clear, the anterior chamber deep, and the pupil 4 mm. in diameter. Saccular herniation of the vitreous had occurred through the pupil. The vitreous was confined by an intact anterior limiting membrane which could be outlined clearly. There were numerous deposits of pigment on the surface of the limiting membrane. Remnants of the lens capsule were firmly attached to its anterior surface. The vitreous gel posterior to the anterior limiting membrane was optically clear. There was practically no aqueous in the anterior chamber. Intraocular pressure was 25 mm. Hg (Schiøtz) in the right eye, and 22 mm. in the left eye. Tension on July 9, 1945, was 45 mm. Hg in the right eye. The acute glaucoma was probably due to the nearly complete filling of the anterior chamber by the intact herniated vitreous which partially obstructed the filtration angle.

The patient was given miotics and operation was advised to reduce the tension and to clear the pupil of opacities for vision. On July 12, 1945, a small incision was made at the upper limbus with a keratome. The vitreous immediately presented at the incision and was removed. Capsular remnants of the lens attached to the anterior limiting membrane of the vitreous were removed with forceps.

The patient made an uneventful recovery. Refraction on July 25, 1945, revealed that with +10.50D. sph. ⊂ +2.75D. cyl. ax. 125°, the visual acuity was 6/7. With the addition of a +3.0 sphere, his visual acuity was 14/21, according to the American Medical Association reading chart.

Comment

Traumatic herniation of the vitreous body into the anterior chamber is rare.[1, 5, 6, 7] It is easily recognized by the biomicroscopic examination.[8, 9] Whether or not blood was present in the dependent portion of the sac in this case would only be conjectural. However, the many scattered deposits of pigment on the anterior limiting membrane may have been the result of hemorrhage.

The anterior limiting membrane in this case was probably a new formation. Paula-Santos[1] called attention to the fact that if the hyaloid membrane is not broken, it must be quite elastic to permit

the vitreous to protrude through the pupil. Then by virtue of its own elasticity it should assume its original position and thereby reduce the herniation. It is more reasonable to assume the formation of a new membrane resulting from a physiochemical response between the vitreous and the aqueous humor rather than a stretching of the hyaloid. It cannot be satisfactorily demonstrated anatomically; moreover, Duke-Elder[10] has shown that the entire vitreous body will pass through a filter paper leaving behind no residue except a homogeneous protein material which is not derived from the surface of the vitreous.

References

[1] Paula-Santos, B. Arch. d'Opht., 1936, v. 53, p. 876.
[2] Duke-Elder, W. S. Textbook of ophthalmology. Diseases of the inner eye. St. Louis, C. V. Mosby Company, 1941, v. 3, pp. 3273-3278.
[3] Cowan, Alfred, and Fry, W. E. Amer. Jour. Ophth., 1932, v. 15, p. 428.
[4] Cowan, Alfred. Amer. Jour. Ophth., 1932, v. 15, p. 125.
[5] Butler, T. H. Brit. Jour. Ophth., 1933, v. 17, p. 343.
[6] Haab, O. Zeit. f. Augenh., 1900, v. 3, p. 113.
[7] Hesse, Robert. Zeit. f. Augenh., 1919, v. 42, p. 191.
[8] Berliner, M. L. Biomicroscopy of the eye: Slit lamp microscopy of the living eye. New York, Paul B. Hoeber, Inc., 1943, v. 1, pp. 581-586.
[9] Butler, T. H. An illustrated guide to the slit-lamp. London, Hazell, Watson, and Viney, Ltd., 1927, pp. 119-121.
[10] Duke-Elder, W. S. Textbook of ophthalmology. St. Louis, C. V. Mosby Company, 1933, v. 1, pp. 117-463.

CYCLODIALYSIS IN THE TREATMENT OF GLAUCOMA*

SAMUEL D. MCPHERSON, JR., M.D.
Baltimore, Maryland

Cyclodialysis was described by Heine in 1905 as a procedure for the surgical treatment of chronic primary glaucoma.[1] Since then it has been used in the treatment of all recognized types of the disease. It is the purpose of this paper to report the results in 140 cases when cyclodialysis was performed. These cases may be divided into three categories: (1) chronic primary glaucoma, (2) glaucoma following cataract extraction, and (3) glaucoma secondary to active uveitis.

MATERIAL

This report is based on the case histories of patients with these three types of glaucoma in whom cyclodialysis was performed in the Wilmer Institute between January 1, 1927, and January 1, 1944. In determining the final results in the three types of glaucoma, the classification "success" was used only in those histories with follow-up periods of one year or more; the definition of "success" being that the tension was controlled within normal limits for a minimum period of one year. On the other hand, for the classification "failures," all case histories were used in which there was any record of consistently or repeatedly elevated tension after the operation, irrespective of the period of observation. In all cases the tension was taken with a Schiøtz tonometer, and any tension over 29 mm. Hg was considered elevated. Operations in all cases were performed by members of the resident or full-time staff of the Wilmer Institute.

TABLE 1

RESULTS OF CYCLODIALYSIS IN CHRONIC PRIMARY GLAUCOMA, GLAUCOMA FOLLOWING CATARACT EXTRACTION, AND GLAUCOMA SECONDARY TO UVEITIS

Type of Glaucoma	Cases Followed One Year	Cases with Tension Less Than 30 mm. Hg (Schiøtz)	Percentage
Chronic primary	45	19	42
Following cataract extraction	39	14	35.9
Secondary to uveitis	31	2	6.5

RESULTS

The results in these three types of glaucoma are given in table 1.

Chronic primary glaucoma. Cyclodialysis was performed in 56 eyes with chronic primary glaucoma. In 12 of these cases, cyclodialysis was performed as the initial procedure. In 9, it was a second operation following an unsuccessful iridencleisis, in 15 it similarly followed an unsuccessful trephining, and in 20 cases, it followed two or more previously unsuccessful operations for glaucoma. Forty-five of these cases were followed for at least one year. In 19 cases (or 42 percent) the cyclodialysis was successful, and the patient maintained a normal intraocular pressure for the year (see table 1). Only one of these 19 successful cases subsequently developed an increase of tension greater than 30 mm., the duration of follow up in this case being 2½ years.

In table 2 these cases are classified according to the depth of the anterior chamber. Thus the operation was performed in 16 eyes with deep anterior chambers, of which 14 were followed for one year or more; 10 (or 71 percent)

* From the Wilmer Opthalmological Institute of the Johns Hopkins Hospital and University.

maintained a normal intraocular pressure at the end of the period of observation. Cyclodialysis was performed in 18 eyes with shallow anterior chambers, 12 of which were followed for one year or more. Only five (or 42 percent) had a normal tension at the end of the period of observation. This difference, although not statistically significant, suggests that cyclodialysis may be more effective in eyes with deep than in eyes with shallow anterior chambers.

In the total of 56 cases of chronic primary glaucoma which are here analyzed, the operation in 27 cases was a failure in that the intraocular pressure was not maintained within normal limits for a period of one year. In 14 (or 52 percent) of these, the failure was evident in the first 14 postoperative days, and in 21 (or 78 percent) it was evident in the first postoperative month. At the end of the first postoperative year, 26 (or 96 percent) of the failures had occurred. This suggests that if the operation is not successful, the failure usually becomes apparent soon after the operation.

TABLE 2

EFFECT OF DEPTH OF ANTERIOR CHAMBER IN CHRONIC PRIMARY GLAUCOMA

Anterior Chamber	Cases Followed One Year	Cases with Tension Less Than 30 mm. Hg (Schiøtz)	Percentage
Deep	14	10	71
Shallow	12	5	42

Glaucoma following cataract extraction. Cyclodialysis was performed in 53 eyes with glaucoma following cataract extraction, and 39 were followed for a minimum of one year. In 14 of these eyes (or 35.9 percent) the operation was successful in that the tension was still normal at the end of one year, although in two cases, followed 2½ years, the tension later rose.

In 33 of these eyes cyclodialysis was performed as the initial procedure, and 26 of these 33 eyes were followed at least one year; 10 (or 38.5 percent) maintained a normal intraocular pressure during this period. In 20 additional eyes, cyclodialysis was performed as a second operation, the eyes having had at least one previous operation for the glaucoma. Thirteen of these eyes were followed for at least one year. In 4 (or 30.8 percent) the cyclodialysis was successful, and the eyes had a normal tension at the end of this time. This similarity of results suggests that the presence or absence of previous operative procedures may have little effect on the success of cyclodialysis.

TABLE 3

EFFECT OF DEPTH OF ANTERIOR CHAMBER IN GLAUCOMA FOLLOWING CATARACT EXTRACTION

Anterior Chamber	Cases Followed One Year	Cases with Tension Less Than 30 mm. Hg (Schiøtz)	Percentage
Deep	19	9	47
Shallow	15	4	27

These cases are also analyzed according to the depth of the anterior chamber (table 3). Twenty-four of the patients had deep anterior chambers, and of these, 19 were followed for at least one year. At the end of this time, 9 (or 47 percent) still had a normal tension. Twenty-two of the eyes had shallow anterior chambers, and of these 15 were observed for at least one year. At the end of that time, only 4 (or 27 percent) still maintained a normal intraocular pressure. This suggests that cyclodialysis may be more successful in

aphakic eyes with deep anterior chambers than in those with shallow ones.

There were 27 failures in the 53 eyes of this series. Ten (or 37 percent) of these failures were evident in the first 14 postoperative days, and 15 (or 55.5 percent) in the first month. By the sixth postoperative month, 25 (or 92.6 percent) of all failures had occurred. This again suggests that failure of cyclodialysis to maintain normal intraocular pressure is most likely to occur in the first six postoperative months, and that if intraocular pressure is maintained at a level of less than 30 mm. Hg for this period of time, it is unlikely to rise at a later date.

TABLE 4

INCIDENCE OF COMPLICATIONS

Complication	Eyes Operated on	Number of Complications	Percentage
Anterior-chamber hemorrhage	140	87	62.1
Vitreous hemorrhage	140	8	5.7
Laceration of Descemet's membrane	140	7	5
Hypotonia	140	3	2.1

In 11 cases of these 27 failures, a second cyclodialysis was done without another intervening operative procedure. In 4 of these (or 36.3 percent), the follow-up period varying from three months to three years following the last operation, the tension was successfully controlled. In the remaining seven eyes, the second operation likewise was a failure.

Glaucoma secondary to active uveitis. Cyclodialysis was performed in 31 eyes with glaucoma secondary to active uveitis, and all were observed for at least one year. In 16 of these eyes, the cyclodialysis was obviously unsuccessful within the first 14 postoperative days, whereas in 15, the tension was still normal. At the end of the first postoperative month, eight of these 15 eyes still had a normal tension, and this was maintained in six at the end of three months. However, at the end of one year only two of these (or 6.5 percent of the original cases) had a tension less than 30 mm., whereas 29 (or 93.5 percent) had an intraocular pressure of more than 30 mm. Hg (Schiøtz). Each one of these 29 cases subsequently required another operative procedure for the persisting glaucoma. This strongly suggests that cyclodialysis is not effective as a procedure to give any lasting control of glaucoma secondary to uveitis.

COMPLICATIONS

The most frequent early complications of cyclodialysis were anterior-chamber hemorrhage and vitreous hemorrhage. Anterior-chamber hemorrhage occurred in 87 of 140 eyes operated on, an incidence of 62.1 percent (table 4). There was little difference in the incidence in the three types of glaucoma involved. Hemorrhage usually occurred at the time of operation (52.9 percent), but was occasionally seen first at the time of the first dressing (6.5 percent). In the later postoperative course, hemorrhage was uncommon, being present in only three eyes (2.1 percent).

Fifty-six cases of chronic primary glaucoma and 53 cases of glaucoma following cataract extraction were analyzed according to the severity of anterior-chamber hemorrhage (tables 5 and 6). Of the 56 eyes with chronic primary glaucoma, 36 eyes had either no hemorrhage or one occupying less than one fourth of the anterior chamber. Twenty-eight of those eyes were followed for at least one year. At the end of that time 15 (or 54 percent) had a normal tension. Twenty eyes were observed with hemorrhages oc-

cupying more than one fourth of the anterior chamber. Sixteen of these were followed for at least one year, and in only 4 (or 25 percent) was a normal tension present at the end of this period. This suggests that hemorrhage occupying more than one fourth of the anterior chamber may predispose to failure of the operation. The same holds true in aphakic eyes. Of the 53 cases in this group, 40 had either no anterior-chamber hemorrhage or one occupying less than one fourth of the chamber. Twenty-eight of these cases were observed for at least one year, and at the end of that time, in 12 (or 43 percent) the operation was successful. In 13 cases hemorrhages occupied more than one fourth of the anterior chamber, and of 11 cases followed at least one year, only 2 (or 18 percent) maintained a normal tension. In one case, the anterior-chamber hemorrhage resulted in occlusion of the pupil.

TABLE 5

EFFECT OF ANTERIOR-CHAMBER HEMORRHAGE ON THE CONTROL OF CHRONIC PRIMARY GLAUCOMA

Amount of Hemorrhage	Cases Followed One Year	Cases with Tension Less Than 30 mm. Hg (Schiøtz)	Percentage
None, or less than one fourth of anterior chamber	28	15	54
One fourth or more of anterior chamber	16	4	25

Vitreous hemorrhage occurred in 2 of 56 eyes with chronic primary glaucoma, in 6 of 53 eyes with glaucoma following cataract extraction, and not at all in 31 eyes with glaucoma secondary to uveitis. This represents an over-all incidence of 5.7 percent. In only one of these eight eyes was there any final reduction of vision attributable to the hemorrhage.

Two late complications of cyclodialysis encountered in this series were hypotonia and lacerations of Descemet's membrane. Hypotonia occurred in three of 140 eyes operated on, an incidence of 2.1 percent, but in no instance resulted in a decrease of final visual acuity. Lacerations of Descemet's membrane occurred in seven of 140 eyes operated on, an incidence of 5 percent, but again in no case did it result in a reduction of final visual acuity.

TABLE 6

EFFECT OF ANTERIOR-CHAMBER HEMORRHAGE ON THE CONTROL OF GLAUCOMA FOLLOWING CATARACT EXTRACTION

Amount of Hemorrhage	Cases Followed One Year	Cases with Tension Less Than 30 mm. Hg (Schiøtz)	Percentage
None, or less than one fourth of anterior chamber	28	12	43
One fourth or more of anterior chamber	11	2	18

Discussion

A survey of the literature reveals varied reports of the final results obtained following cyclodialysis. These range from 28 percent reported by Meissner and Sattler[2] to 77.8 percent reported by Gradle.[3] The latter's results were obtained in cases of chronic simple glaucoma with no inflammatory reaction. Comparable results were obtained in this series in a group of cases similar to Gradle's, those with chronic primary glaucoma and deep anterior chambers. Spaeth reports cyclodialysis to be successful in 45 to 50 percent of cases.[4] His series included, in addition

to cases of chronic primary glaucoma, cases of inflammatory glaucoma and those in which other operations for glaucoma had been performed. Similar results were obtained in the present series in that group of cases which included all types of chronic primary glaucoma. It seems that probably the best results would be obtained in primary glaucoma by adhering to Gradle's dictum and performing cyclodialysis only in chronic simple glaucoma without inflammatory reaction.[5]

The widely accepted belief that cyclodialysis is a harmless procedure is given further proof in this series; for, in spite of an incidence of anterior-chamber hemorrhage of 62.1 percent and of vitreous hemorrhage of 5.7 percent, only two of 140 eyes operated on showed any reduction of vision as a result of these complications. In addition, there was no instance of postoperative infection.

The low incidence of success in glaucoma secondary to active uveitis, the low incidence of success in eyes with shallow anterior chambers, and the poor results obtained after severe anterior-chamber hemorrhage point to some obstruction of the angle of the anterior chamber as the probable cause of failure of the procedure. If one accepts Barkan's conclusion that the establishment of a communication between the anterior chamber and the suprachoroidea is a mechanical *sine qua non* in the successful action of cyclodialysis, it is easy to understand the failure in these cases.[6]

Because of the relative frequency of anterior-chamber hemorrhage and its untoward effects on the prognosis following cyclodialysis, various procedures to prevent hemorrhage were made at operation. These include cauterization of episcleral vessels prior to scleral incision, pressure over the sclera during withdrawal of the spatula and for a short time thereafter, and the use of the Randoph spatula to irrigate the chamber once hemorrhage has occurred. The relative efficacy of these measures was impossible to evaluate.

Summary

The results of cyclodialysis in 140 eyes with chronic primary glaucoma, glaucoma following cataract extraction, and glaucoma secondary to uveitis are analyzed.

(1) Cyclodialysis resulted in an intraocular pressure of less than 30 mm. Hg (Schiøtz) in 42 percent of 45 cases with chronic primary glaucoma, in 35.9 percent of 39 cases with glaucoma following cataract extraction, observed for one year, but only in 6.5 percent of cases of glaucoma secondary to active uveitis.

(2) Cyclodialysis was more effective in eyes with deep than with shallow anterior chambers in both chronic primary glaucoma and glaucoma following cataract extraction.

(3) Failure of cyclodialysis to maintain intraocular pressure at less than 30 mm. Hg (Schiøtz) was most likely to be evident in the first postoperative month, 78 percent of the failures in chronic primary glaucoma, and 55.5 percent in glaucoma following cataract extraction being noted in this period. Practically all failures occurred in the first year; 96 per cent of those in chronic primary glaucoma and 92.6 percent of those in glaucoma following cataract extraction.

(4) In glaucoma following cataract extraction, after the failure of one cyclodialysis to control tension, a second cyclodialysis was successful in 36.3 percent of 11 cases so treated.

(5) Anterior-chamber hemorrhage occurred in 62.1 percent of 140 eyes operated on. Hemorrhage occupying more than one fourth of the anterior chamber prejudiced the control of intraocular pressure in eyes with chronic primary glaucoma and in those with glaucoma follow-

ing cataract extraction, but smaller hemorrhages had no deleterious effect.

(6) Vitreous hemorrhage occurred in 8 of 140 eyes operated on, an incidence of 5.7 percent. In only one case was there a reduction of vision directly attributable to the vitreous hemorrhage.

(7) Postoperative hypotonia was encountered in 2.1 percent of 140 cases and lacerations of Descemet's membrane in 5 percent. In no case did these result in a reduction of final visual acuity.

References

[1] Heine. Deutsche Med. Woch., 1905, v. 21, p. 824.
[2] Meissner and Sattler. Graefes Arch., 1909, v. 71, p. 1.
[3] Gradle, H. S. Amer. Jour. Ophth., 1931, v. 14, pp. 1101-1103.
[4] Spaeth, E. B. Trans. Amer. Acad. Ophth. and Otol., 1928, p. 178.
[5] Gradle, H. S. Amer. Jour. Ophth., 1920, v. 3, p. 41.
[6] Barkan, Boyle, and Maisler. Amer. Jour. Ophth., 1936, v. 19, pp. 21-25.

UNAIDED VISUAL ACUITIES CORRELATED WITH REFRACTIVE ERRORS

A STUDY

MORRIS H. PINCUS, MAJOR (MC), A.U.S.

Introduction

With the passage of the Selective Service Act, in 1940, and especially after the attack on Pearl Harbor by the Japanese, many men and women, the volunteers as well as those who were called to serve their country, came to the Army Induction Stations and General Dispensaries for their physical examinations.

These centers were overtaxed with applicants. Complete and impartial physical examinations had to be conducted with the meager means at hand, and opinions had to be given regarding the fitness or unfitness of the individual for military duty. Sometimes these opinions were made hurriedly, sometimes under extreme pressure.

The ocular examinations came to be regarded as of great importance. Many applicants who desired to enter the military service tried to hide visual defects, either by not mentioning them or by attempting to evade their detection. A few who wished to evade military service entirely as well as those anxious to obtain a noncombatant classification exaggerated a known visual defect or stated that one existed.

It is pertinent to mention these two groups—negative and positive ocular malingerers—because the writer found that their existence created a very definite need for some systematized method of correlating the unaided visual acuity with the refractive error, provided the correcting lenses brought the visual acuity of the eyes to the accepted Snellen standard of 20/20, when no organic disease was present.

For example: If three individuals possessing correcting lenses of -1.50D. sph. $\bigcirc\!\!\!\!\!\!-$ -1.00D. cyl. ax. 180°, which gave them normal vision, presented themselves for examination, and the unaided visual acuity of one was 20/200, of the sec-

ond 20/100, and of the third 20/300, an average uncorrected visual-acuity reading of 20/200 would be obtained. It would then be reasonable to expect an unaided visual-acuity reading in the vicinity of 20/200 from others who possessed correcting lenses of that power, provided no organic ocular lesion was present.

As has been stated, the unaided visual acuity of any group of persons who possess the same corrective power of lenses would vary. Numerous factors—such as age, fatigue, foci of infection, malnutrition, accommodative power—would cause such variations, but there would be a reasonable range of such variation.

A chart or charts containing the average unaided visual-acuity data and the visual ranges for each of the corrective lenses most commonly encountered would materially aid an examiner in the detection of malingerers, and in classification.

The opportunity for such study presented itself in two ways. The great majority of the men and women who came for the physical examination prior to induction to the service were applying as officer candidates. The general average-intelligence level of these people was somewhat above that of the average inductee, and their responses during the ocular examination were somewhat more reliable. This, however, does not exclude a considerable portion of this group from the two classes of ocular malingering mentioned previously. Secondly, when the Army began to issue spectacles to its personnel, requests for refractions increased by leaps and bounds. The officers and enlisted men presenting themselves for an ocular examination and refraction, as a whole, no longer had any reason to be positive or negative malingerers. Many came because they were told that they needed glasses; a number came because they thought that this was a good opportunity to have their spectacles changed; others, because they desired an ocular examination.

Methods

The physical-examination records of 45,206 men and women as well as 7,482 refraction records were reviewed for this study. Since each square of the presented charts represents the unaided visual acuity of an eye that obtained standard vision with the corresponding correcting lens or lenses, all records that showed vision correctable to 20/20 in the absence of organic disease were retained for tabulation.

All of the examinations were performed at an Army General Dispensary. The author personally examined more than half of these individuals, and the remainder were examined by associates trained in his routine methods of examination.

Each examinee, whether present for a routine physical examination or for an ocular examination and refraction, was impressed with the fact that squinting would not be permitted.

The American Optical Company Projecto-Scope and Screen were used throughout these examinations. Visual acuities were tested at 20 feet from the screen. The unaided visual acuity of each eye as well as binocular vision was recorded. Individuals who had unaided visual acuity of less than 20/400 in one or both eyes, were slowly walked up to the 400 figure until it was accurately identified. The distance between the examinee and the screen was then recorded as the numerator and 400 as the denominator. No one chart or figure was used consistently. Four different Projecto-Scope charts were used interchangeably, so that no one could familarize himself with nor memorize them.

Each eye was then examined for patho-

logic lesions and a notation made of any existing abnormality. Following this, the spectacles (if any) of the examinee were neutralized, and the vision of each eye, separately, and the binocular vision with the glasses were noted. If the vision in each eye was not corrected to 20/20, a rapid retinoscopic examination was performed with the aid of the trial-case frame and lenses. The best visual acuity obtained for each eye and the strength of the correcting lenses in the trial-case frame were recorded on the physical-examination sheet. Fundus studies were made on all whose vision in either eye was not correctable to 20/20; on all whose unaided visual acuity was 20/100 or worse; and on all who gave a history of ocular pathologic change.

All military personnel under the age of 40 years, with no contraindications noted, received a cycloplegic examination. The manifest refraction of those over 40 years was recorded. Fundus studies were made in every instance.

Method of tabulation

Fifty charts for each refractive group, exactly as those presented, were attached to a large board. The upper row represented the Hyperopic group, the middle row represented the Myopic group, and the lower row the Mixed-Astigmatism group.

As each record was reviewed, the refractive error was noted, and the square corresponding closest to that error was filled with the unaided visual acuity, and the age of the individual. As the squares of the lower refractive errors quickly filled the 50 charts of each group, additional charts were attached in order to include all such unaided visual acuities.

With the review of records completed, loose-leaf pages, each marked consecutively to correspond to the refractive errors, were made up in book form—one book for each refractive group.

Each page had the refractive error, age groups, and axes arranged in the manner shown in table 1. The recorded unaided visual acuities were then transposed to the proper pages and inserted under the correct age-group and axes columns.

These columns were individually added, and the total divided by the number of figures in that column. This gave the average unaided visual acuity for that particular refractive error and age group. Immediately below each column the extremes of unaided visual acuity were recorded and enclosed in parentheses.

Since the average unaided visual-acuity figures are impracticable for use by the average examiner, the writer converted them to the nearest Snellen equivalent.

For example: In table 1 the average unaided visual acuities are: 35, 32, 38, 37, 44, 41, 52, 50, 52, 49, 61, 57. When converted to the nearest Snellen equivalent they become: 30, 30, 40, 40, 40, 40, 50, 50, 50, 50, 60, 60.

Results

Table 2 represents the average unaided visual-acuity findings of eyes, with no organic pathologic lesions which are correctable to 20/20 by the corresponding lens corrections in the three main refractive-error groups.

The great majority of the unaided visual-acuity readings are accounted for in the triangular region of 0 to 4.00D. spheres and 0 to 3.00D. cylinders, singly, and in combination, in all refractive groups. Myopic corrections predominated. The vacant spaces noted appear particularly in the oblique-axis columns and signify that these corrective lenses were not encountered in this study.

The unaided visual acuities under the oblique-axis cylinder corrections are, as a rule, slightly less than those found under the horizontal or vertical meridians.

As the average age in the Hyperopic group increased, the average unaided visual acuity for the same correcting lenses became increasingly worse. This is physiologic and to be expected.

The age factor in the Myopic and in the Mixed-Astigmatism groups, apparently does not materially influence the results of the unaided visual acuity for the same correcting lenses.

nately, the methods of recording visual acuity are not uniform. Many letters of affidavit for applicants testify to such lack. Many ocular prescriptions for spectacles from military installations brought similar evidence.

To obtain a proper record of visual acuity the head and eyes of the examinee must squarely face the chart. No squinting, head tilting, nor turning must be permitted. The vision should be tested both with and without glasses, provided glasses are worn, and the monocular as well as the binocular vision noted in each instance.

TABLE 1

TABULATION OF THE UNAIDED VISUAL ACUITIES FOR A REFRACTIVE ERROR WITH VARIOUS CYLINDER AXES, IN THE DIFFERENT AGE GROUPS*

Example: +1.50D. sph. ⊂ +0.50D. cyl.

18–29				30–39				40+			
1	2	3	4	1	2	3	4	1	2	3	4
40	40	40	40	40	40	70	50	50	50	50	50
30	30	40	30	50	40	50	40	50	40	50	70
30	30	30	30	50	40	50	50	70	40	70	70
50	25	50	50	40	50	50	70	40	70	100	50
30	40	40	40	40	30	40	40		50	50	50
40	40	30	30		40		50	4 | 210	50	50	70
30	25		40	5 | 220	50	5 | 260	50		40		50
30	40	6 | 230	40		40			52	40	6 | 370	50
40	30		30	44	40	52	7 | 350		70		
	30	38	40		40				40	61	8 | 460
9 | 320							50				
	10 | 320		10 | 370		10 | 410				10 | 490		57
35											
	32		37		41				49		
(30–50)	(25–40)	(30–50)	(30–50)	(40–50)	(30–50)	(40–70)	(40–70)	(40–70)	(40–70)	(50–100)	(50–70)

Figures 18–29, 30–39, 40–, represent the different age groups.
Figures 1, 2, 3, 4, represent axes 45, 90, 135, and 180, respectively.
The average unaided visual acuity is recorded at the base of each column.
Each figure represents the denominator of the Snellen fraction, 20/.
The figures in parentheses represent the range of unaided visual acuity.
* The figures in each column represent but a fraction of the actual number tabulated for this refractive error.

The average unaided visual acuity of the Mixed-Astigmatism group, as a whole, was much better than that found in either of the other two groups.

In all groups, the average unaided visual acuities became worse as the refractive power of the correcting lenses increased.

As an interesting feature in this study, it was noted that Mixed-Astigmatism occurred more frequently in women.

Comment

Visual-acuity records, for the ophthalmologist, for the patient, and for statistics, are exceedingly valuable. Unfortu-

The Army physical-examination requirements specifically state that if the vision is within such and such range and correctable to such and such a value the individual will be classified thus, and so on. Any number of applicants are borderline problems, and an examiner is hard pressed to determine with a clear conscience just how to classify these individuals.

This study was undertaken because a need was felt for some simple expression

0.
1.
1.
2.
2.
3.
3.
4.
4.
5.
5.
6.

0.
1.
1.
2.
2.
3.
3.
4.
4.
5.
5.
6.

0.
1.
1.
2.
2.
3.
3.
4.
4.
5.
5.
6.

TABLE

AVERAGE UNAIDED VISUAL ACUIT

HYPERO

+CYLINDER

	Axes	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°	18
	0	0.50				1.00				1.50				2.00				2.50				3.00			
0		25	25	25	25	30	30	30	30	30	40	40	50	60	50	60	60		60	60	70	80	80	80	
0.50	25	30	30	30	30	40	40	40	40		40	50	50	60	60	60		70	70	80			80	80	
1.00	30	30	30	30	30	40	40	50	40		50		50		70	70			80		100	100	100	100	1
1.50	30	30	30	40	40	50	40	50	50	60	50	50	60	70	70	80	80		100	100			100		2
2.00	40	40	40	50	50	60	60	60	60		70		70	80	80	80			100	100			200		
2.50	50	40	40		50		60	60	70	80	80		80		80		100		100				200		
3.00	60	60	70		80	70	70	80	70	100	100		100		100				200		200	200	200	200	
3.50	70	80	80	80	100	80	80		80	100	100				100				200				200		
4.00	80	80	80		100		100	100	100		100	100	100	200	200				300				200		
4.50	100		100		200	200	100	200							200		200		300				400		
5.00	200	200	200				200			200	200		300						300						
5.50	200		200		300		200				300														
6.00	300				300				300								400		400				400		

MYOPIA

−CYLINDER

	Axes	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°	18
	0	0.50				1.00				1.50				2.00				2.50				3.00			
0		30	30	30	30	40	40	40	40	60	60	50	50	80	80	80	70	100	100	80	80	200	200	200	1
0.50	30	40	40	40	40	40	60	50	50	80	70	70	70	100	80	100	80	100	150	100	100	200	200	200	2
1.00	50	80	70	70	70	80	100	100	80	100	100	100	100	150	150		100	200	200	200	200	200	200	200	2
1.50	80	100	100	100	100	150	150	150	150	200	200	200	150	200	200	200	200	200	200		200				2
2.00	100	200	200	200	200	200	200	200	200	200	300	300	250	300	300		300	300	300	300	300	300	300	400	3
2.50	200	200	200	250	250	250	250	300	250	300	300	300	300	300	300	300	300	300	300		300		400		4
3.00	300	300	300	300	300	300	300	300	300	400	400	400	400	400	400	400	400		400		400	400		400	4
3.50	300	400	400	300	300	400	400	400	400	18/400	400	400	400		18/400		18/400		16/400		16/400				18/4
4.00	400	400	400	400	400	15/400	15/400	16/400	16/400	18/400	18/400	15/400	16/400	15/400	15/400		15/400	10/	14/400		16/400				12/4
4.50	17/400	16/400	17/400	16/400	18/400	16/400	15/400	15/400	15/400	15/400	13/400	13/400.	13/400	12/400	12/400	14/400	13/400	12/400	12/400	12/400	11/400		10/400		12/4
5.00	15/400	15/400	13/400	13/400	15/400	12/400	13/400	7/400	12/400	10/400	12/400	10/400	12/400	10/400	11/400	10/400	10/400	15/400		9/400	10/400	10/400	10/400	10/400	10/4
5.50	13/400	11/400	9/400	11/400	12/400	11/400	14/400	12/400	14/400	10/400	12/400	11/400	12/400	8/400	10/400		9/400		8/400	9/400	10/400		8/400		8/4
6.00	9/400	7/400	9/400	8/400	10/400	9/400	10/400	4/400	8/400	5/400	8/400	5/400	8/400		8/400		8/400			8/400	10/400			5/400	5/4

MIXED ASTIGM

+CYLINDER

	Axes	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°	180
	0	0.50				1.00				1.50				2.00				2.50				3.00			
0																									
0.50						30	30	30	30	40	40	50	40	60	60	70	60		70	80	70	80	80	100	
1.00										60	60	60	60	70	60	70	70		80	80	80	100	100	100	10
1.50															70		70	80	80	100	100	100	150	100	10
2.00																			100	100	100		150	200	15
2.50																							150	200	20
3.00																									
3.50																									
4.00																									
4.50																									
5.00																									
5.50																									
6.00																									

Each figure represents the denominator of the Snellen fraction.
When the numerator is less than 20/, it is recorded.

TABLE 2

Average Unaided Visual Acuity for Age Groups 18–40+

HYPEROPIA

	180°	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°
		2.50				3.00				3.50				4.00		
	60		60	60	70	80	80	80	80		100		100		100	
		70	70	80			80	80	80		100				100	
			80		100	100	100	100	100		100				200	
	80		100	100			100		200	200	200				200	
			100	100			200			200					300	
	100		100				200				200				300	
			200		200	200	200	200			200				400	
			200				200								400	
			300				200									
	200		300				400									
			300													
	400		400				400									

MYOPIA

	180°	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°
		2.50				3.00				3.50				4.00		
0	70	100	100	80	80	200	200	200	100	200	200	200	200	200	200	300
0	80	100	150	100	100	200	200	200	200	200	200	200	200			
	100	200	200	200	200	200	200	200	200	200		200	200			
0	200	200	200		200				250		300	300	300	300		300
	300	300	300	300	300	300	300	400	300			300	300		400	400
0	300	300	300		300		400		400				400		15/400	
0	400		400		400	400		400	400	15/400	18/400		17/400			
	18/400		16/400		16/400				18/400				15/400			
	15/400	10/	14/400		16/400				12/400		10/400		12/400			10/400
00	13/400	12/400	12/400	12/400	11/400		10/400		12/400							
00	10/400	15/400		9/400	10/400	10/400	10/400	10/400	10/400							
	9/400		8/400	9/400	10/400		8/400		8/400		6/400					
	8/400			8/400	10/400			5/400	5/400				4/400			

MIXED ASTIGMATISM

5°	180°	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°
		2.50				3.00				3.50				4.00		
70	60		70	80	70	80	80	100		100	100	100			100	
70	70		80	80	80	100	100	100	100		100	200	100	100	150	200
	70	80	80	100	100	100	150	100	100		100	100	200		150	200
			100	100	100		150	200	150	150	150	100	200		200	
							150	200	200		200		200		200	200
										200	200		200	200	200	
															200	300

	135°	180°	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°	180°
4.00			4.50				5.00				5.50				6.00			
			200	200		200		200				200						
			200	200		200		200										
				200		200		200										
								200										
			200	200														
				300				300										

	135°	180°	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°	180°	45°	90°	135°	180°
4.00			4.50				5.00				5.50				6.00			
	300	200		300		300		400	300	300								15/400
		200																
		300				300	300			400				400				
	300	300				18/400		16/400		15/400				15/400				
	400	400	15/400	15/400		18/400				14/400				10/400				
0		16/400				14/400												
		12/400				10/400												
		10/400				10/400				15/400								
	10/400	10/400				8/400												
		10/400								6/400								
										4/400								
						6/400												2/400

	135°	180°	45°	90°	135°	180°	45°	90°	135°	180	45°	90°	135°	180°	45°	90°	135°	180°
4.00			4.50				5.00				5.50				6.00			
		100		150			300	300										
	200			200				300				300				400		
	200			200	200	200		300		300		300						
				200				300				400						
	200			300				300						400				
		200		300				300				400	400					
	300			300		300		300		300		400				400		
					400			400				400				400		
								400				400						
																	10/400	

by which an examiner could rely on the answers given. Such information would be of value not only for mobilization and demobilization purposes, but for certain phases of civilian life as well.

Only eyes free from organic defects and with vision correctable to the accepted Snellen standard of 20/20 within the range of 0 to 6.00D. spheres and 0 to 6.00D. cylinders, in half-diopter increases, singly and in combination, in all three refractive-error groups, were selected for this study.

Thorington,[1] in his book on refraction, stated, "The visual acuity under definite conditions is an index of the strength of the necessary spherical lenses (plus or minus) which will give a vision of VI/VI or more. For instance, the question which has been decided is this: If a healthy eye, Hyperopic or Myopic, without astigmatism (or an eye with its astigmatism corrected with a cylinder) has the ability to see VI/VI, and has its ciliary muscle under the effect of 'drops,' what strength spheric lens would be required to give it normal vision? To begin with the writer had to work backward, so to speak, and in the following manner: The eyes were tested at six meters, and with the lenses which gave standard vision the eyes were tested to find out what the visual acuities would be when plus spheres were placed in front of the correcting lenses."

Agatston,[2] in his paper on "Ocular malingering," presented a table on the correlation of uncorrected visual acuity with the refractive error for myopia, myopic astigmatism, and compound myopic astigmatism based on the results of experiments with six Army men. "These subjects, each with less than 1 diopter of refractive error, had full correction, and, one eye being used at a time, the various refractive states were simulated by employment of plus lenses at the anterior focal plane. . . . If necessary, the examiner, using himself as a subject, may properly simulate any refractive error he may encounter."

In both instances, simulation was the method chosen. Though the conclusions are noteworthy, they were based on too few observations.

The author, with the help of his assistant, did simulate the different refractive errors. It was soon apparent, however, that no matter how truthful he attempted to be, he could not avoid recognizing figures or numbers which were blurred, and which would, no doubt, be unrecognizable to an individual whose unaided visual acuity was correctable to the normal value by the corresponding refractive corrections used.

In this study the recorded unaided visual acuities of more than 50,000 individuals, men and women, of different age groups were correlated with the refractive errors.

The great majority of the unaided visual-acuity readings were encountered in the region of 0 to 4.00D. spheres and 0 to 3.00D. cylinders, singly, and in combination, in both the Hyperopic and Myopic refractive groups. These average unaided visual-acuity readings are highly accurate. Beyond the 4.00D. spheres and 3.00D. cylinders, singly, and in combination, fewer readings for these corrective powers were obtained. Though fairly accurate, they do not possess the high degree of accuracy noted for the corrective-lens combinations mentioned previously. The empty spaces noted occur particularly in the oblique-axis columns and signify that such refractive errors were not encountered in this study. They could, however, be filled by interpolation. Other studies of this character, made on greater numbers of individuals, would help to fill these blank spaces and to corroborate

the work which has already been accomplished.

Armed with such information, an examiner would be aided materially in the detection of malingerers. It would help in classification and assignment of individuals entering the service. Many individuals will, no doubt, claim compensation for visual impairment aggravated by the stress and strain of war. Except for those with traumatic or organic pathologic lesions of the eyes, the truth or falsity of such claims in subjects who have unaided visual acuities correctable to 20/20, with lenses, the refractive power of whose eyes had not changed, would be readily determined. Positive malingerers will, of course, be tested with other corroborative methods.

In certain phases of civil life—for example, in the case of compensation work, civil suits, insurance—such information can be of great value.

Similar charts for the Navy can be constructed by using the Conversion Formula of Allen.[3]

Conclusions

A study, correlating the unaided visual acuities with the different refractive errors, obtained from a review of more than 50,000 physical examination and refraction records at an Army General Dispensary, is presented.

Only eyes free from organic defects and correctable to 20/20, within a range of 0 to 6.00D. spheres and 0 to 6.00D. cylinders, singly, and in combination, in all three refractive-error groups, were selected for tabulation.

This study was undertaken because a need was felt for some simple expression by which to determine and confirm the truth or falsity of answers given by applicants during the ocular examinations.

The importance of this study is reflected in the fact that, armed with such information, borderline individuals could be properly classified, and malingerers detected. Such information is of practical value not only for mobilization and demobilization purposes, but for certain phases of civilian life as well.

References

[1] Thorington, James. Refraction of the human eye and methods of estimating the refraction. Ed. 2, Philadelphia, P. Blakiston's Son & Co., Inc., 1930.
[2] Agatston, Howard. Ocular malingering. Arch. of Ophth., 1944, v. 31, March, pp. 223-231.
[3] Allen, D. G. Conversion formula for Snellen symbols. Arch. of Ophth., 1943, v. 30, Dec., pp. 810.

NOTES, CASES, INSTRUMENTS

A METHOD OF EVISCERATION OF THE EYEBALL*

RALPH W. DANIELSON, M.D. AND JOHN C. LONG, M.D.

Denver, Colorado

From time to time for many years articles have appeared on the subject of enucleation as compared to substitute operations. For a detailed discussion of the indications and contraindications for each, one may find an excellent portrayal of the subject in the American Encyclopedia of Ophthalmology for 1915[1] and in articles by Burch,[2] Guibor,[3] and very recently in the published report of the symposium by Gradle,[4a] O'Brien,[4b] Kirby,[4c] and Pfeiffer[4d] at the 1944 session of the American Academy of Ophthalmology and Otolaryngology. Spaeth[5] discusses the question in his book. Weigelin[6] wrote on the subject in World War I.

We shall refer to only a few of the numerous variations in surgical technique in performing eviscerations. Gifford[7] in 1900 reported 14 cases of simple evisceration (leaving the cornea) and favored this above the ordinary evisceration which is combined with keratectomy. In his operation, Gifford made a meridonial incision three fourths of an inch long through the sclera midway between the external and superior recti, extending from within 3 mm. of the corneal margin toward the posterior pole of the eye. The contents of the eye were then scraped out through this incision, which was held apart with hooks or forceps. The scleral shell was collapsed by inserting gauze beneath the lids. Gifford stated that he had much less postoperative edema when he had used this method than after following the ordinary procedure for evisceration.

In a subsequent paper, Gifford[8] redescribed his evisceration technique. He believed that the Mules operation gave the best cosmetic result, but thought that the pushing of the anterior half of the eye into the posterior half was almost as good. Grimsdale and Brewerton[9] have discussed evisceration technique in detail. Burch[2] has urged evisceration with preservation of the cornea. Others, including Huizinga,[10] have recommended making an opening in the sclera posteriorly to permit drainage of fluid from the scleral cavity.

Burch,[2] in discussing his method of evisceration, advises as additional safety factors the wiping off of the endothelium from the cornea and the application of iodine to the scleral cavity, followed by cocaine neutralization and by irrigation. Other authors have recommended other chemical treatments of the cavity.

Potechina[11] reported a scleral cyst following evisceration of the eye. Mahoney[12] says he favors evisceration in many cases, but does not favor it if there is injection of the ciliary body, even if the surgery is done promptly after an injury.

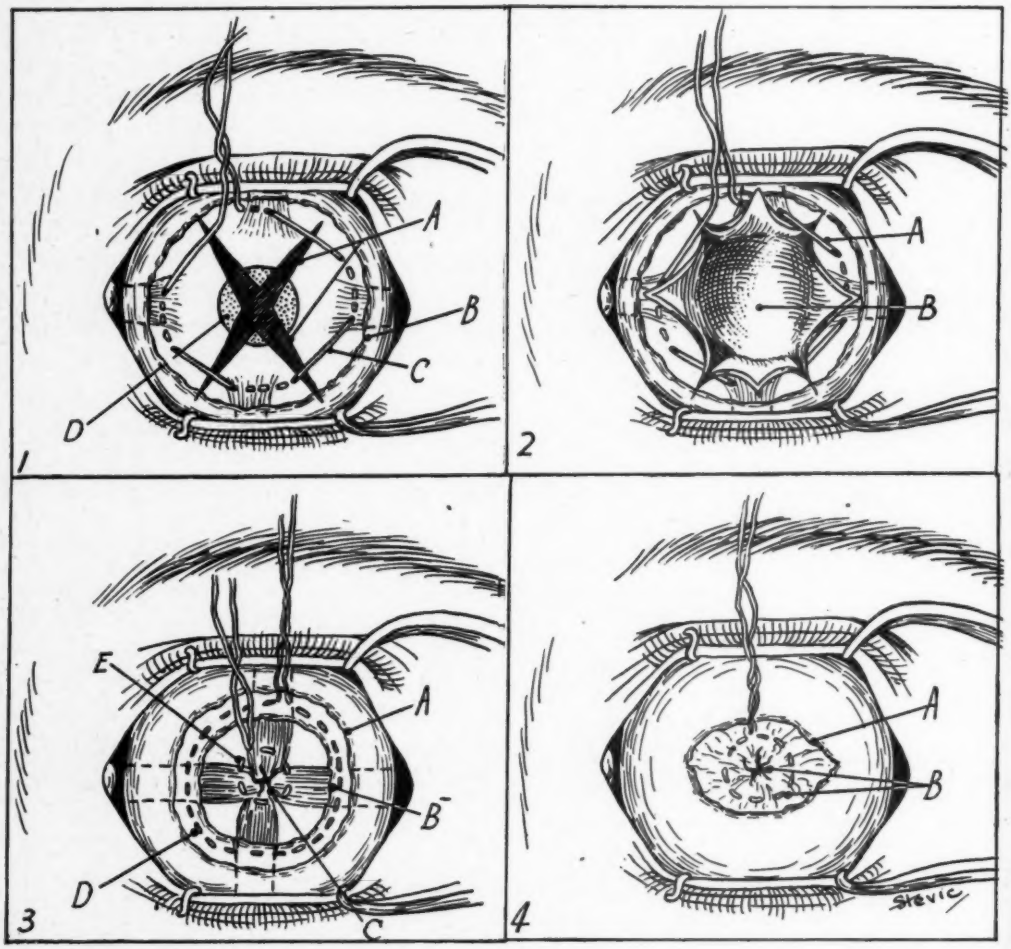
Dimitry[13] describes his evisceration technique in which he (1) cuts off the cornea and the sclera, including the ciliary-body region; (2) cuts out a piece of the sclera posteriorly, including a piece of the optic nerve; (3) implants a ball; and (4) makes V-shaped cuts in the sclera to allow it to fit more snugly over the gold ball. This is a modification of the Mules[14] operation.

O'Connor,[15] in 1930, described a technique of evisceration quite similar to the one which we have independently employed.

Several years ago, when confronted with a case of gross corneal laceration

* From the University of Colorado School of Medicine.

with extrusion of the scleral contents, the authors decided to perform an evisceration in a somewhat unconventional manner. We had previously noted cases of evisceration with keratectomy in which the sclera remained for a considerable period as an open, secretion-filled cup. To avoid this difficulty, the sclera was made to collapse in the following manner: The corneal and scleral lacerations were enlarged and supplemented by additional incisions back to the equator. A purse-string suture was inserted about the equator, and the anterior portion of the eye was then invaginated into the posterior half and the sutures tied. A second purse-string



Figs. 1-4 (Danielson and Long). Steps in performing evisceration. Fig. 1, appearance of eye with incisions made but lips almost closed. A, incisions in cornea and sclera; B, edge of conjunctiva; C, purse-string suture; D, cornea. Fig. 2, appearance of eye with lips held open and evisceration completed. A, purse-string suture; B, showing everted, cleaned sclera. Fig. 3, appearance after invaginating anterior lips into posterior portion by tying first purse-string suture. A, edge of conjunctiva; B, edge of Tenon's capsule; C, dimpled, inverted center; D, 2d purse-string suture; E, 1st purse-string suture. Fig. 4, appearance after both purse-string sutures are tied, before closing conjunctiva. A, edge of conjunctiva; B, position of first and second purse-string sutures.

suture in Tenon's capsule combined with conjunctival sutures closed the wound. The result was excellent, and the technique has since been used on several occasions very satisfactorily.

The following steps are taken in performing the operation:

1. Circumcision of the conjunctiva at the limbus and retraction of conjunctiva and Tenon's capsule.

2. Four or more incisions, or extension of lacerations, of the cornea and sclera back to or somewhat beyond the equator (fig. 1).

3. Evisceration of contents of globe with curette and gauze. A small suction tip is of value in keeping the field clear. One must wait for complete hemostasis. Some surgeons might wish to treat the interior chemically (fig. 2).

4. Placing of chromic catgut sutures in the sclera.

5. Invaginating the anterior sections into the posterior portion (figs. 3 and 4).

6. Interrupted plain 5-0 catgut closure of conjunctiva.

7. Pressure bandage with adhesive which is allowed to remain from two to three days before changing.

The advantages of this operation are: 1. The sclera acts as the implant. 2. The interior can be thoroughly cleaned. 3. The recti muscles are connected with the implant. 4. The healing is rapid. 5. The final cosmetic result is excellent. 6. Patients may be up and about and out of the hospital the day after surgery if necessary, especially if a pressure bandage is applied. 7. No implant to be extruded.

This operation seems particularly suited to cases of severe laceration of the anterior segment. It can also be used in painful eyes such as ones with absolute glaucoma or in those removed for cosmetic reasons. In these latter cases the first purse-string suture could be inserted before the eyeball is opened.

This type of evisceration is contraindicated in cases of acute endophthalmitis, for thereby organisms may be introduced into the peribulbar tissues. The operation can probably be safely done in cases of long-standing endophthalmitis because of a decrease in the virulence of the infection and a partially acquired immunity to the offending organisms. It would seem to be good practice to administer penicillin and sulfonamides in all cases in which the possibility of infection exists.

Summary

The literature of the last 30 years on methods of evisceration has been reviewed briefly.

A method of evisceration, very similar to the one of O'Connor, is described.

324 Metropolitan Building (2).

References

[1] American Encyclopedia of Ophthalmology, 1915, v. 6, pp. 4382-4475.

[2] Burch, Frank. Evisceration of the globe with scleral implant and preservation of the cornea. Amer. Jour. Ophth., 1940, v. 23, p. 47.

[3] Guibor, George. Simple evisceration of the globe versus simple enucleation. Arch. of Ophth., 1933, v. 10, July, p. 63.

[4] Transactions of the American Acad. of Ophth. and Otolaryn., 1945, March and April, p. 225. Symposium on enucleation and substitute operations. Discussion of factors important for better cosmetic effect.

(a) Gradle, H. S. Enucleation versus evisceration.

(b) O'Brien, C. S. Enucleation and substitute operations.

(c) Kirby, D. B. Enucleation of the eyeball with immediate implantation into Tenon's capsule.

(d) Pfeiffer, R. L. Effect of enucleation on the orbit.

[5] Spaeth, E. B. Principles and practice of ophthalmic Surgery. Philadelphia, Lea and Febiger, 1939, p. 116.

[6] Weigelin, S. Enucleation or evisceration. Brit. Jour. Ophth., 1918, v. 2, p. 585.
[7] Gifford, H. On strictly simple evisceration of the eyeball. Arch. of Ophth., 1900, v. 29, p. 422.
[8] ———. On the technique of evisceration. Ophthalmoscope, 1914, v. 12, Jan., p. 18.
[9] Grimsdale and Brewerton. Textbook of ophthalmic operations. 1920, p. 181.
[10] Huizinga, J. G. Eviscero-neurotomy; A new operation. Jour. Amer. Med. Assoc., 1900, v. 34, p. 394.
[11] Potechina. A case of scleral cyst following evisceration of the eye. Russki Ophth. Jour., 1929, April, p. 485.
[12] Mahoney, G. W. Some indications for evisceration. Amer. Jour. Ophth., 1920, v. 3, p. 611.
[13] Dimitry, T. J. An operation relegating enucleation of the eye to its proper position. Amer. Jour. Ophth., 1919, v. 2, p. 653.
[14] Mules, P. H. Evisceration of the globe, with artificial vitreous. Trans. Ophth. Soc. United Kingdom, 1885, v. 5, p. 200.
[15] O'Connor, R. Exenteration of the ocular contents by a new technique. Arch. of Ophth., 1930, v. 3, p. 151.

SCLEROMALACIA*

FREDERICK A. KIEHLE, M.D.†
Portland, Oregon

At the meeting of the Academy of Ophthalmology and Otolaryngology held in New York City in 1936, I reported under the above title[1] the case of a woman, then 64 years of age, who had been the victim of rheumatism for 21 years.

At the time of her death, last October, she had been bed-ridden for 18 years with deforming arthritis.

Both eyes had been completely immobile for the preceding five years, fixed in the primary position. She was wasted to a skeleton. Her spine was rigid. There had been only perception of light for some years. Ocular pain was never intense, and rather best described as a burning sensation. This could be relieved by mild ointments. In the early stages of her condition the retinas could be seen, but evinced no pathologic change. The vitreous was clear. For a long time, however, the corneas had been opaque. It was assumed that tension was normal, although application of a tonometer was inadvisable. On autopsy it was found that all extrinsic muscles were degenerated and reduced to mere cords. Absorption of the sclera had advanced well beyond the equator. There was in each eye an adhesion of the bulbus to the upper lid. Although no perforation of the sclera could be demonstrated, it is probable that perforation had occurred, thus accounting for the adhesion of the bulbus to the upper lid and bringing the case under Van der Hoeve's classification of scleromalacia perforans. (Van der Hoeve stated[2] that one of his cases had been under observation for 40 years before perforation took place.)

On enucleation of the right eye, the sclera, exceedingly thin throughout in each eye, was punctured at this point of adhesion. The vitreous was like water and entirely escaped. Even greater care was exercised in removing the left eye, and at the point of attachment to the upper lid a segment of tarsal conjunctiva was included. Thus the bulbus was removed intact. Both eyeballs seemed enlarged.

Pathologic diagnosis (report by Army Medical Museum): Scleromalacia (perforans?). Chronic active iridocylitis.

"A (left eye). Behind the equator the sclera appears fairly normal; at the insertion of the recti muscles the fiber bundles are broken, the sclera becomes thin-

* From the Department of Ophthalmology, University of Oregon Medical School.
† Professor emeritus of Ophthalmology.

ner and almost disappears over the ciliary body. The iris and the ciliary corona are diffusely infiltrated with chronic inflammatory cells, most of them of the lymphocyte series. Eosinophiles are fairly numerous and Russell bodies are present. The iris is stretched and somewhat attenuated by adhesions of the pupillary border to the cornea. The cornea is thin, irregular in width, vascularized. Bowman's membrane is absent, and the anterior lamellae are infiltrated with chronic inflammatory cells. The corneal epithelium is thickened, and irregular in width; Descemet's membrane is thick.

"The lens is not in place but was sectioned separately. It is small, irregular in outline, the anterior capsule wrinkled, and beneath it is a large amorphous deposit containing calcium granules. The capsular epithelium has disappeared in the center of the anterior surface over the amorphous deposit.

"B (right eye). This globe is partially collapsed (artefact); otherwise the picture is similar to the other eye. There is greater destruction of the sclera; the cellular infiltration of the cornea is slightly less marked; and the iris involvement more extensive. There are peripheral anterior synechiae as well as pupillary ones. In the pupillary area are pink masses adherent to the anterior and posterior surface of the iris, which appear to be hyalinizing scar tissue but may represent lens remnant. The cross section of the optic nerve of this eye shows a sector of atrophy."

As a further contribution to the subject I quote from a letter from Sir Stewart Duke-Elder, who writes: "The patient with scleromalacia whom I saw in March was a woman of 56 who had been suffering from polyarthritic rheumatism for about 30 years, and is now a complete cripple with most of her joints ankylosed. The right eye showed two large areas over which the sclera had completely disappeared, exposing the uvea, and in the left eye, all around the ciliary region, a similar condition existed, there being only one or two bands of sclera remaining. In the left eye there was a circular ulcer all round the cornea, of an atrophic indolent type. Nothing in the picture suggested inflammation.

"I am proposing to do a mucous membrane graft from the lip to cover the exposed areas sometime in the near future.

"Apart from the very few references quoted in the second volume of my textbook I know of no more recent publications on this very rare condition. You can quote anything of this you like."

Thus little by little may be gathered together the facts having to do with this unusual condition. There is undoubtedly a connection between scleromalacia and deforming arthritis. It is to be hoped that this relationship can be established and explained.

1020 Southwest Taylor.

References

[1] Kiehle, F. A. Scleromalacia. Amer. Jour. Ophth., 1937, v. 20, June, pp. 565-570.
[2] Van der Hoeve, J. Personal communication.

EPIDERMOID CARCINOMA OF THE CORNEA

ARTHUR J. BEDELL, M.D.
Albany, New York

This condition is not extremely rare. There are, however, comparatively few reports in the current literature and still fewer that combine photographs and the pathologic report.

A man, aged 74 years, gave a history of a corneal disease which started 18 years before I first saw him. He said that in the beginning there was a small spot on the side of "the clear part" (the cornea) of his left eyeball. He saw a physician, but no treatment was advised; so, during all of these years, he sought no further counsel, although from time to time the eye bled for a few days. He was conscious that his sight was steadily diminishing, and for the past several months knew that he was blind in that eye. He definitely stated that he had never had pain.

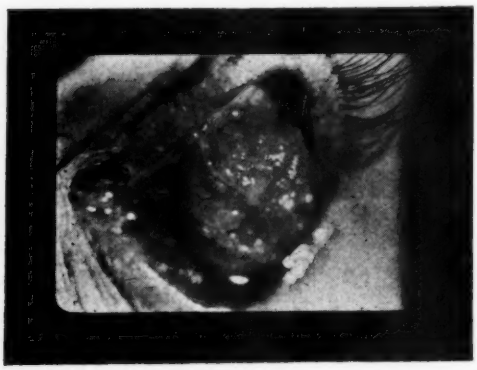


Fig. 1 (Bedell). Epidermoid carcinoma of the cornea. Left eye. Umbilicated, rough, nodular tumor mass covering the entire cornea.

The right eye was essentially negative. With a correcting lens the vision was 20/20. There were no external evidences of inflammation and no fundus alterations.

The left eye was blind, the eyelids were free, the eyelid borders were not congested, the cilia were normal in number and size. The conjunctiva was only slightly injected near the junction of the inner canthus and lower lid. The entire cornea was an elevated, vascular mass with umbilication near the center (fig. 1). The surface was rough, lobulated, and nodular. There was a very narrow, crescentic extension beyond the nasal limbus; otherwise the bulbar conjunctiva and sclera were uninvolved. There were several fine vessels and an occasional larger one in and on the pale-pink friable tumor, which was several millimeters thick. A thin, mucopurulent discharge was adherent to the surface of the growth.

The patient was advised to have the eye enucleated. Following the operation he made an uneventful recovery.

The eyeball was sent to Dr. T. L. Terry of Boston, whose report follows:

Pathologic diagnosis. Epidermoid carcinoma, Group II, involving the cornea.

Microscopic description. At the level at which the sections were made, the entire cornea is covered with a relatively thick epidermoid carcinoma, Group II. In some places, the tumor is 3 mm. thick.

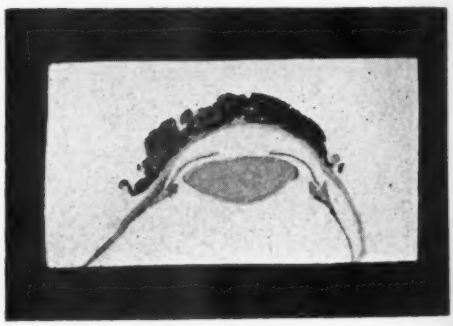


Fig. 2 (Bedell). Epidermoid carcinoma of the cornea. Profile section showing the irregular surface, variable thickness, and neoplastic extension over the nasal limbus.

Its surface is irregular (fig. 2). Carried with it is a moderately large amount of stroma which contains a somewhat irregular distribution of blood vessels (fig. 3). In some places, the stroma is relatively vascular; in others, it appears almost avascular. Bowman's membrane has been eroded and destroyed over relatively large areas. At the central portion of the cornea, however, some Bowman's membrane is seen to be still present. The tumor does not appear to have gone into the substantia propria at any place. The cornea is infiltrated with wandering cells rather irregularly, some of which have taken on a flattened shape like corneal corpuscles (fig. 4). There is also some vascularization of substantia propria; vascularization is in the more superficial parts. Mesenchymal epithelium is absent in places. The iris angle is open, and the ciliary processes show some hyalinization. The lens cortex contains a few acidophilic vacuoles. The retinal separation appears to be a post-mortem change.

Fig. 3 (Bedell). Epidermoid carcinoma of the cornea. Low-power magnification, ×55.

The photograph of the gross specimen shows the discrete and confluent nodules which are clearly distinguished by the differences in level.

On section, the tumor was found to be confined to the cornea except for a few millimeters beyond the nasal limbus.

This case is presented because of its unusual extent and the fact that it might be mistaken for leprosy and, of course, the reverse holds, that a leproma might

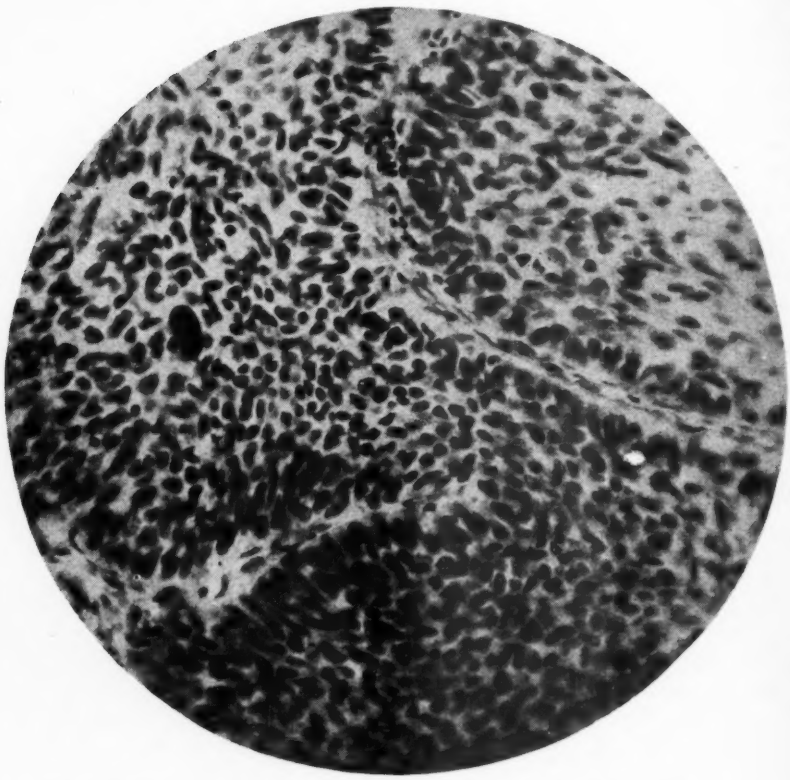


Fig. 4 (Bedell). High-power magnification, ×335. Characteristic cells and grouping.

be mistaken for a malignancy. The latter is improbable on the part of any observant physician, for the corneal leproma is a late manifestation and the other stigmata of advanced leprosy would be evident.

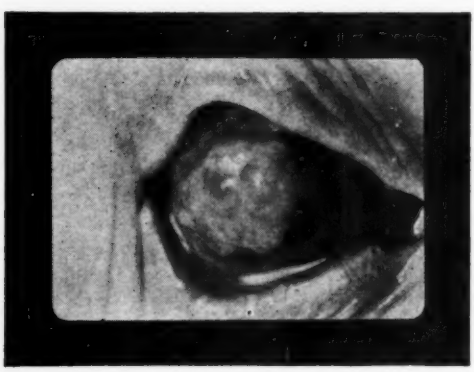


Fig. 5 (Bedell). Leproma. Smooth nodular corneal growth. The absence of the eyelashes confirms the diagnosis.

A photograph of a leproma is presented (fig. 5) to illustrate the practically complete loss of eyelashes, the bulbar conjunctival congestion and the tumor, the surface of which was smoother and not so uniform in thickness as the carcinoma. There was less tendency to bleed, although the vessels were larger than those in the neoplasm. The other eye was also affected for in leprosy both corneas are practically always involved.

A tuberculoma of this size would have other concomitant signs of tuberculosis and local inflammation.

344 State Street.

CHOICE OF GRAFTS FOR ORBITAL RECONSTRUCTION

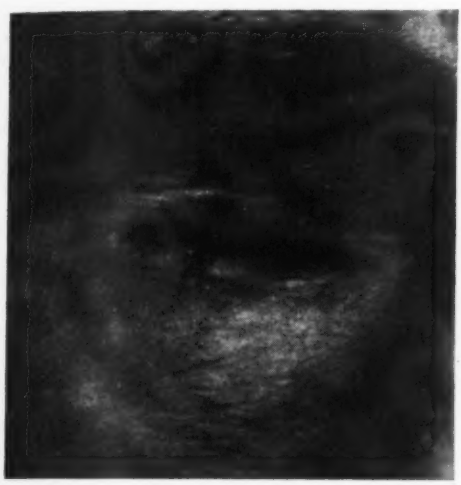
CHARLES M. MACKENZIE, M.D.
Spokane, Washington

When a graft is necessary to line the orbital cavity in orbital reconstruction, the choice of graft is important.

Since Virchow first suggested that loss of mucous membrane be replaced by skin, the epidermal layer of skin has been used, until recent times, for resurfacing cavities such as the mouth, nose, orbit, vagina, and others, despite the fact that its epithelial cells become macerated, exfoliate, and produce a foul-smelling discharge.

Wolfe[1] was the first to report the success of mucous-membrane transplants, and, following the demonstration of Esser[2] that free grafts could be successfully applied as a lining to replace mucous membrane of the mouth by placing the graft around a mold or stent (epithelial-inlay grafting), the problem of cavity lining has been somewhat simplified.

The ideal graft in orbital lining is mucous membrane, and the choice of donor site will depend on whether the patient is male or female. Having tried all the available donor sites, I have listed these in the order of their preference: Male—(1) mucous membrane of mouth;



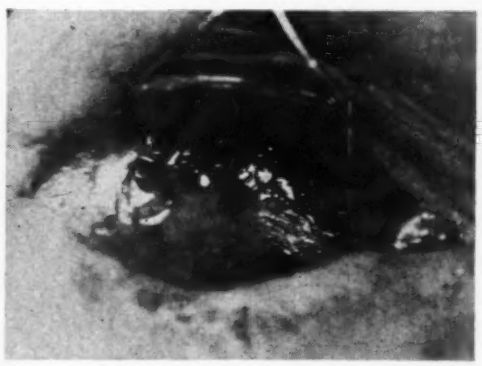


Fig. 2, Same patient as in figure 1. Shows orbital cavity relined with rectal mucosa.

Figs. 1-3 (MacKenzie). Reconstruction of orbit, using lining of rectal mucosa. Fig. 1, Patient as he appeared after several previous attempts at reconstruction. Note the typical depression of the upper lid and the nick in the center of the tarsal cartilage.

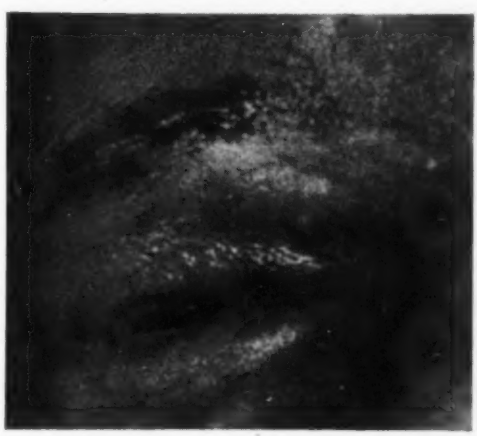


Fig. 3, Same patient as in figures 1 and 2. Shows the stent containing the orbital graft in place with eyelids sutured together. The nick in the tarsal cartilage has been corrected, and the normal contour of the upper lid has been restored by a transplant of fascia lata inserted through an incision in the hair line of the eyebrow.

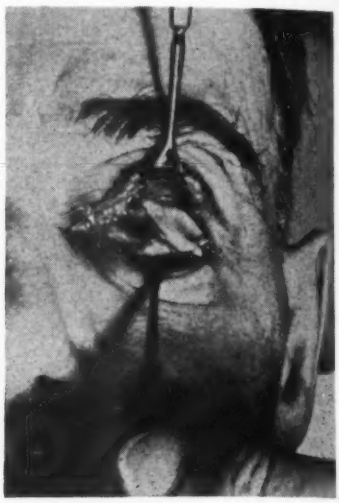
(2) mucous membrane of prepuce; (3) rectal mucosa; (4) nasal mucosa. Female —(1) vaginal mucous membrane; (2) oral mucous membrane; (3) rectal mucosa; (4) nasal mucosa. The nearest approach to a completely successful orbital graft, following several previous failures from preferred donor sites, was accomplished in one case with rectal mucosa.

Fig. 4 (MacKenzie). Same patient as in figures 1-3, showing end results.

Fig. 6, Same patient as in figure 5. Orbital cavity relined with mucous membrane from prepuce.

The difference in the glandular character of these various sites is not important because of the tendency of the glandular elements to become modified by change of environment.

The choice of donor site is determined by simple surgical principles; namely, the source that can supply the tissue which most closely simulates the conjunctiva; that can be removed with least difficulty; and that will cause minimum inconvenience to the patient. Only on rare occasions will the surgeon be called upon to choose between nasal and rectal mucosa. Of



Figs. 5-7 (MacKenzie). Reconstruction of orbit using lining of mucous membrane taken from the prepuce. Fig. 5, Condition prior to operation.

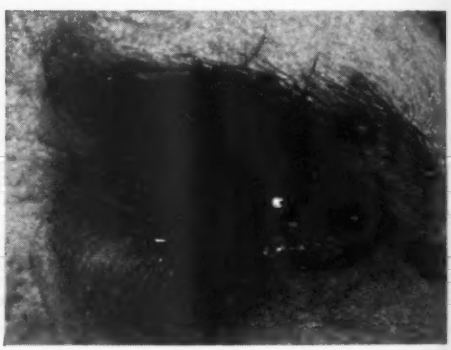


Fig. 7, Same patient as in figure 6. End results.

equal importance to the choice of a donor site is the making of an accurately fitting stent.

Dental modeling compound or wax has never met the requirements for orbital impressions because both distort the tissues and offer difficulties in sterilization. These are largely avoided by using the hydrocoloid-impression material with especially designed, water-cooled trays. More recently the coloid powder, which I autoclave for 15 minutes and mix with sterile water, further simplifies orbital impressions by eliminating the need for the cumbersome, water-cooled trays. The stents are made of clear acrylic (lucitone) and kept in 70-percent alcohol until used.

581 Paulsen Medical and Dental Building.

References

[1] Wolfe. New method of performing plastic operations. Brit. Med. Jour., 1875, v. 2, p. 360.
[2] Esser. Neue Wege für chirurgische Plastiken durch Heranziehung der Zahnärztlichen Technik. Beitr. z. klin. Chir., 1916, v. 103, p. 547.
[3] ——. Studies in plastic surgery of the face. Ann. Surg., 1917, v. 65, p. 297.

RETINAL DETACHMENT SECONDARY TO CONGLOMERATE TUBERCLE OF THE CHOROID

Report of a case

H. D. Harlowe, Major (MC), A.U.S.

Solitary or conglomerate tubercle of the choroid is a rare form of ocular tuberculosis. The first descriptions of this condition in medical literature were those of Von Graefe, Jaeger, Manz, Bouchert, Frankel, Haab, Cohnheim, and Weis. The forms described are: (1) choroidal miliary tubercles, (2) granuloma or solitary tubercle. The first is often associated with acute miliary tuberculosis and the second with chronic tuberculosis.

Conglomerate tubercle of the choroid is, as a rule, unilateral; it occurs most frequently in children and is probably secondary to tuberculosis in other parts of the body. According to Zur Nedden, it has occurred in 62-year-old individuals. Examination with the ophthalmoscope reveals it as an intraocular mass, yellowish white in color. Retinal involvement may occur with subsequent retinal detachment. The diagnosis is often difficult because one must differentiate the tuberculoma from the following pathologic processes: Retinoblastoma or glioma in children, sarcoma in adults, occasional metastatic deposits of carcinoma in the choroid, idiopathic retinal detachment, retinal cyst, and Coats's disease (massive exudates). Enucleation and laboratory confirmation may be necessary in some cases to establish the diagnosis. According to Verhoeff, this condition is inadequately described in textbooks. Recent publications by Berens, Troncoso, and Wolff discuss this subject.

Case report

A white man, aged 27 years, was admitted to the hospital on August 20, 1944. His previous history included three months' hospitalization for retinal detachment of the right eye of undetermined origin. Prior to the hospitalization, he had complained of impaired vision, severe headaches, and redness of the right eye. Examination revealed a large retinal detachment present in the right eye from the 11- to the 2-o'clock position. The cornea and lens were clear. The disc margins were quite indistinct, and there

was a pale, yellowish-white mass, about one disc diameter in size, in the right inferior temporal quadrant. The tension appeared to be within normal limits. Vision in the right eye was reduced to perception of finger movements. Previously, the patient's visual acuity had been 20/20, O.U. No abnormal findings were discoverable in the left eye.

Laboratory findings. Red blood cells, 4,600,000; white blood cells, 7,500: neutrophiles 58 percent; lymphocytes 30 percent, eosinophiles 12 percent (hookworm); hemoglobin, 94 percent. The Wassermann test and urinalysis were negative. Roentgenograms of the skull, sinuses, and chest were within normal limits. Ova of Necator americanus were present. Sputum examination was negative for tubercle bacilli. Urinalysis for melanuria was negative.

Treatment and Course. The diagnosis of hookworm was established, and adequate treatment was given. The patient complained of persistent, severe headaches, and a feeling of pressure behind the right eye. Narcotics were necessary to relieve these symptoms. Enucleation was performed on November 7, 1944, because of a possible choroidal tumor. The headaches were somewhat relieved after the operation, but soon returned. On February 27, 1945, the patient received a plastic prosthesis for the right eye. His case was followed for approximately a year after the operation; he still complained of severe headaches that occurred once or twice a week and lasted for one or two days. Repeated roentgenograms of the skull were negative. Neurologic examination was entirely negative. The pathologic diagnosis was: Granuloma, chorioretinitis, possible tuberculosis (Ash).

Intradermal tuberculin tests after the pathologic report was received were positive to a very weak dilution of old tuberculin. The sections were reviewed by Klien, who commented as follows: "Sections through the chorioretinal lesion show it to be an old hypertrophic type of chorioretinal scar. The granulation tissue seems to contain some epithelioid cells in addition to the rather obvious giant cells, and the still-preserved portions of the choroid have slight round-cell infiltration. This may be a tuberculoma, an assumption rather supported by the findings in the celloiden section. In this section the retinal periphlebitis, the numerous preretinal precipitates, and the mild optic neuritis would fit very well into the picture of a solitary tuberculous lesion in the eye, the retinal manifestations distant from the lesion being an allergic reaction."

Comment

A review of the literature by Horning and Lamb included 55 cases of tuberculoma of the choroid. A few cases have since been added. The condition is usually unilateral, but both eyes may be involved. Verhoeff is of the opinion that "Retinal tubercules do not arise by direct metastasis through the blood stream, but are produced by infected cells which have invaded the vitreous."

Burch replied in regard to this case: "I have never felt quite satisfied with a diagnosis of tuberculoma. In a few sections of that title which I have, I have not been able to demonstrate the tubercule bacilli in them, although the diagnosis was made on the usual pathologic findings. In this case the possibility of 'foreign body giant cells' was suggested." Dodds reported a case of tuberculoma in which all the tissues of the eye were involved. Many tuberculous giant cells were present. Direct smears from the enucleated eye failed to disclose any tubercle bacilli. A guinea pig was inoculated with smears from the eye.

and later the acid-fast bacilli were found.

Finnoff stated: "Conglomerate tuberculoma are often fortunately diagnosed as malignant and only correctly diagnosed microscopically after enucleation." The use of graduated tuberculin skin tests may help in the differential diagnosis. Tuberculous lesions may also appear in other organs as well as the eye, especially the brain. The persistent cephalalgia in this case might be explained on that basis.

Summary

1. A case of conglomerate tubercle of the choroid with laboratory confirmation is reported.

2. The first diagnosis in this case was idiopathic retinal detachment.

3. The eye was enucleated because of a suspected melanosarcoma of the choroid.

4. The final diagnosis was not confirmed until after the pathologic report was received.

5. The tuberculin skin test may at times be of aid in establishing a diagnosis.

6. A correct diagnosis is often difficult to arrive at in these cases.

References

Ash, J. E. Personal communication to the author.

Berens, Conrad. The eye and its diseases. Philadelphia, W. B. Saunders, 1938, p. 681.

Bouchert, M. Des tubercles de la choroïd et de la retine pouvant servir au diagnostic de la tuberculose cérébrale. Gaz. de Hop., 1869, v. 2.

Burch, F. E. Personal communication.

Cohnheim, J. Ueber Tuberculose der Chorioidea. Virchows Arch. f. path. Anat., 1867, v. 39, pp. 49-69.

Dodd, G. E. Tuberculoma of the eye. Brit. Jour. Ophth., 1941, v. 25, pp. 387-389.

Finnoff, W. C. Colorado Med., 1921, v. 18, May, No. 5.

Frankel, B. Weitere Beobachtungen von Aderhauttuberkeln. Berlin. Klin. Woch., 1869, v. 6, pp. 37-39.

Haab, O. Die Chorioiditis tuberculosa chronica. Arch. f. Ophth., 1879, v. 25, pp. 221-236.

Horning, E. S., and Lamb, H. D. Cyto-pathological studies of tuberculoma of the choroid. Jour. Cancer Research Committee of the University of Sydney, 1933, v. 5, May 1, no. 1, pp. 3-10.

Jaeger, E. Ueber chorioideale Tuberkel. Oesterr. Zeit. f. prakt. Heilk., 1855, v. 1, pp. 9-10.

Klien, B. A. Personal communication.

Manz, W. Tuberculose der Chorioidea. Arch. f. Ophth., 1858, v. 4, pt. 2, pp. 120-126.

Troncoso, M. U. Tuberculosis of the choroid. In his "Internal diseases of the eye." Ed. 2, Philadelphia, F. A. Davis Co., 1942, pp. 458-462.

Verhoeff, F. H. Histologic observations in a case of localized tuberculous chorioretinitis. Arch. of Ophth., 1929, v. 1, Jan., pp. 63-70.

Von Graefe, A. Präparat von Chorioiditis tuberculosa bei einem Schweine. Arch. f. Ophth., 1855, v. 2, p. 210.

——, and Leber, T. Ueber Aderhauttuberkeln. Arch. f. Ophth., 1868, v. 14, pp. 183-206.

Weis, L. Ueber die Tuberkulose des Auges. Arch. f. Ophth., 1877, v. 22, pp. 57-158.

Wolff, E. Pathology of the eye. Ed. 2, London, H. K. Lewis & Co., 1944, pp. 81-84.

Zur Nedden. Beitrag zur Kenntnis der tuberkulosen Aderhautgeschwulst. Klin. M. f. Augenh., 1903, v. 41, p. 351.

SOCIETY PROCEEDINGS

Edited by DONALD J. LYLE, M.D.

ROYAL SOCIETY OF MEDICINE

SECTION OF OPHTHALMOLOGY

February 8, 1945

MR. P. E. H. ADAMS, *president*

Abstracted by permission from the Proceeding of the Royal Society of Medicine (Section of Ophthalmology), 1945, volume 38, number 3, sectional page 25.

INJURY TO THE LEFT EYEBROW ASSOCIATED WITH SEVERE VISUAL LOSS

Mr. E. F. KING presented O. L., a man, aged 35 years. This patient fell up some stairs. He was not unconscious and walked to the hospital where stitches were used to close a lacerated wound of the left eyebrow. His eyes were examined for the first time on January 23, 1945, when he complained that the vision of his left eye had been defective since the accident. He gave no history of previous eye trouble and had never worn glasses.

Vision of the right eye was 6/6. There was early macular degeneration, apart from which the eye was healthy. Vision of the left eye was limited to ability to count fingers in the lower field. There was a stitched, lacerated wound in the outer half of the eyebrow. There was no irregularity of orbital margin; no displacement of globe; and movements were full. No mass was palpable in the orbit. The pupil was very sluggish on direct light stimulation; good consensual reaction. The media were clear. Apart from slight macular degeneration, essentially similar to that present in the right eye, the fundus was normal. The only visual field present was in an area below fixation, extending to the periphery. The X ray failed to reveal any foreign body or fracture of the orbit or optic canal.

When the patient was examined again on February 2, 1945, there was some improvement in central vision, now approximately 2/60. There was slight relative temporal pallor of the optic disc and considerable extension of the field of vision, which now embraced fixation.

DUANE'S RETRACTION SYNDROME

WING COMMANDER A. J. ELLIOT presented this subject. Duane's retraction syndrome is characterized by deficiency of abduction, partial deficiency of adduction, retraction of the globe when the eye is adducted, oblique movement when adduction is attempted, narrowing of the palpebral fissure during adduction, and deficiency of convergence.

The syndrome was described in detail by Duane (1905) in a report of 54 cases of congenital deficiency of abduction with retraction, 5 of which were bilateral. He observed that the retraction of the globe may vary from 1 to 10 mm. on adduction. He felt that the retraction was due to the inextensibility of the external rectus muscle, which failed to enlongate, and hence the internal rectus muscle could contract only by retraction of the eyeball. In 9 of the 54 cases, the affected eye protruded slightly when abducted. Duane believed that the narrowing of the palpebral fissure was not a ptosis, but that it was due to the contraction of the orbicularis muscle, the closure being effected as much by an ascent of the lower lid as by a descent of the upper lid.

An atypical form of the retraction syndrome is the condition of strabismus fixus in which there may be a fibrosis of both the internal and external recti. Aebli (1933) reported two cases of this syn-

drome in which the internal rectus muscle was fibrous and attached to the globe at the equator.

The etiology of the condition is not certain. It is not likely that it is due to a birth injury, as Gifford (1926) reports a typical case of the retraction syndrome in an individual who was born by normal Caesarean section. White (1944) considers that the condition is a congenital aplasia of the rectus muscle.

No treatment is required if there is binocular single vision in the central part of the field of fixation. In cases wherein a disfiguring squint or diplopia is present, the only treatment is surgical. Most commonly a moderate recession of the internal rectus muscle is indicated. However, the surgical procedure may be varied according to the findings in each case.

THE CORROSION OF SHARP-EDGED OPHTHALMIC INSTRUMENTS

MR. J. FOSTER, MR. C. H. LEMAY, and MR. K. I. JOHNSTONE discussed the extent of the problem.

E. F. Kayser, senior technologist, Gillette Industries, Ltd., has shown that: "Rusting may occur on the roughest part of a cataract knife (the ground zone) before use, when supplied ungreased, and that rust spoils edges (to a variable extent owing to marked variations in grinding) quicker than use."

CORROSION IN STORAGE. Due to atmospheric water, salt, and acid, corrosion occurs on all ungreased knives, and is most marked in operating-theater cupboards, which have a water-vapor tension equal to that of shops, but a temperature 4.1° above them. This can be reduced by silica gel and lime desiccators, careful handling, and mineral grease.

ANTIDOTES TO CORROSION IN STERILIZATION. Rusting is worst on the ground zone, on curved edges, and on high carbon steel. Experimental knives and trephines of beryllium bronze proved moderate clinically and substandard by photomicrography.

Hot-air Sterilization is only slightly corrosive and kills spores, but is slow and requires a big outlay on the sterilizer and multiple sets of instruments.

Hot Mineral Oil is noncorrosive and produces complete sterility. It is slow and difficult to remove. If vegetable oil is employed, each heating produces fresh corrosive fatty acids, gummy polymerization, and oxidation products.

Chemical Methods. Alcohol is useless, being corrosive (due to acetic acid and aldehydes) and will not kill even Staphylococcus aureus at 130°C. in one hour. *Phenoloids* (antiseptol) Post's solutions, "Dettol," do not kill spores and require washing or boiling to remove them prior to operation. *Mercurials* (metaphen) attack aluminum and possibly steel. This is reduced by addition of borax. *Formaldehyde* (Bard-Parker solution, Liquor sterilisans) kills spores, but Burlingame says 1 to 18 hours are needed if organic matter is present. As spores are killed with certainty by formaldehyde among noncorrosive chemical agents, grease may interfere with their action, and most of them require preoperative removal by aqueous washing or boiling. The method is not without disadvantages. Admittedly spore infection is rare, although recorded by Silberschmidt, Ulbrich, and Marchesani, and corrosion is slight where exposure to water is minimal (Post's solutions, Dettol, and liquor sterilisans).

Boiling in Water is a simple, detergent, complete, and rapid mode of sterilization. All spores die in five minutes if 2-percent Na_2CO_3 is added to the water. Although the Na_2CO_3 reduces rusting by its alkalinity, some knives are spoiled in it by only half a minute's boiling (a period lethal to all vegetative forms). NaOH and

NH_4OH added to the water prevent rusting, but the risks of carry-over are too great. Chlorates, chromates, phosphates, and nitrites reduce rusting. Neutralin, which is used in dental sterilizers, is superior to Na_2CO_3 alone and could be a useful addition to the dipping technique, but it will not preserve cataract knives for five minutes.

High-Frequency sound and electricity are both possible fields for experiments, although the former is more successful with larger organisms (yeasts), and eddy currents would require both inert atmospheres and special controls to prevent a rise above 200°C. and to avoid tarnish and drawn temper.

CORROSION IN DRYING. Knives last longer in Indian clinics owing to the generally alkaline air, immediate use on sterilization, and immediate drying after section by well-drilled theater teams. We should copy them, for slow pre- and post-operative drying may cause rust as much as boiling.

Na_2CO_3 crystals on the blade produce surprising rust effects, and blood saline and Na_2CO_3 may produce a "cell" on the steel where they touch, and local pitting result. The knife blade, being thin, cools rapidly and therefore dries slowly.

ANTIDOTE TO CORROSION. A possible antidote to corrosion in all three stages may be found in AC.10 (surgical) described by C. H. LeMay, B.Sc., of Manchester Oil Refinery Ltd. AC.10, the lightest of a series of anticorrosive products developed as the result of many thousands of experiments, consists of 95 percent of a light petroleum neutral oil and 5 percent of a complex of sodium salts of petroleum sulphonic acids (the inhibitor). Neither the oil nor the inhibitor alone is an effective corrosion preventive. To obtain optimum protection in a given set of conditions of exposure to corrosive attack, both the oil constituent and the mixture of sodium petroleum sulphonates must be carefully selected and mutually adjusted for compatibility.

AC.10, itself, was not originally prepared for protecting surgical instruments during sterilization; it was selected as the most likely of the existing range to satisfy the special conditions of this type of exposure, and its formula was adjusted to produce the modification known as AC.10 (surgical), referred to below as AC.10 for brevity.

Experiments checked by high-power microscopic examination showed: (1) That a cataract knife (1.55-percent carbon steel) if dipped for 15 seconds in AC.10 can be kept indefinitely in water vapor, or water at room temperature, without rusting. This satisfies storage requirements. (2) That a cataract knife first dipped for 15 seconds in neat AC.10 can be boiled for 55 minutes in a 2-percent w/v solution of $Na_2CO_3 \cdot 10\ H_2O$ in water in which 2-percent v/v of AC.10 has been emulsified, without corrosion. If it is redipped in neat AC.10 every 15 minutes, it can be boiled without corrosion indefinitely. This satisfies sterilization requirements.

After operation a sufficient film remains on the knife to protect it for a reasonable period before cleaning (15 to 20 minutes); after cleaning, the film should be renewed by dipping for 15 seconds in neat AC.10 before putting the knife away for storage.

The emulsion should be prepared by dissolving the soda crystals in a relatively small portion of the total water (distilled or well boiled), adding the AC.10 slowly, with vigorous agitation, to this concentrated solution to form a coarse, concentrated suspension, which is then added to the remainder of the water. A fine homogeneous emulsion is formed when this mixture is boiled in the sterilizer.

The protection afforded by AC.10 is

due to the inhibitor so affecting the relation between interfacial tensions in the metal-water-oil system that a film of oil—effective even if monomolecular—is always preferentially formed on the metal surface. In the course of sterilization, when the ebullition might interfere mechanically with the film, the special balance of its ingredients comes into play: the hydrophobic long-chain radical of the inhibitor molecules remains anchored in the oil while the polar sulphono-group is hydrophilic and permits the formation of an emulsion. Each particle of the boiling liquid therefore carries its own quota of AC.10 with it, and if the film on the instrument is disturbed it may be said to be replaced as rapidly as it is removed.

The effect of emulsifying AC.10 in the soda solution on materials other than metal used in surgical instruments is: *Ivory*—unaffected; *Silk* (experiments by Professor Speakman, University of Leeds)—not significantly affected; *Natural rubber*—elongation 10.5 percent after six hours' boiling—not significant in practice, but synthetic rubbers, which would be totally unaffected, could be substituted if desired; *Insulating varnish*—unaffected; *Glass*—refluxed for 70 hours—insignificant losses; *Aluminum handles*, unless dipped initially in neat AC.10, are slightly attacked by the alkali.

The AC.10 method permits sterilization by boiling, without corrosion, of all instruments for ophthalmic surgery rapidly and simultaneously in existing sterilizers.

As knives can be boiled for five minutes or more in 2-percent $Na_2CO_3 \cdot 10 H_2O$ without harm by the AC.10 technique, one of us (K. I. J.) determined whether protection of the cataract-knife blade by immersion in AC.10 and subsequent boiling in an emulsion of AC.10 in sodium-carbonate solution could be used to replace the customary boiling in a 2-percent solution of sodium carbonate (decahydrate), without invalidating sterilization.

Technique. The blades were sterilized by flaming and each was dipped into a dense suspension of one of the following organisms in broth:

Staphylococcus albus (coagulase negative)
Staphylococcus aureus (coagulase positive)
Bact. coli
Streptococcus pyogenes (from a septicemia)
Pneumococcus type I
Bacillus subtilis (with spores)

After drying, the viability of the organisms on each blade was tested by making a small stab culture in an agar plate, or heated blood-agar plate for the streptococcus and pneumococcus, using only the extreme tip of the blade. Only the pneumococcus failed to give growth in most experiments (see first line of the table).

Each blade was then dipped into (1) cold, sterile AC.10 for 15 seconds, and (2) a 2-percent v/v emulsion of AC.10 in a 2-percent w/v solution of sodium carbonate (decahydrate) in distilled water, at boiling point, for 5 minutes, using a separate tube for each blade and for each reagent. Stab cultures were then made in duplicate with each knife, using the whole length of the blade. In every case, the final stab cultures were sterile after incubation at 37°C. for 18 hours (see the second line of the table).

To test for bactericidal action of the AC.10 and its emulsion, the experiment was repeated, using tubes of emulsion at room temperature (see the third and fourth lines of the table). On Staphylococcus albus and aureus and on B. subtilis, the AC.10 and its cold emulsion had no effect, abundant growth being obtained

in each final stab culture. Bact. coli gave irregular results, no growth being obtained in several experiments, due apparently to the action of the sodium carbonate itself. The streptococcus was killed in all cases at room temperature, whereas the pneumococcus rarely survived drying on the blade.

hibited on the surface of heated blood agar.

CONCLUSION. Protection of inoculated cataract knives with AC.10 and incorporation of AC.10 as a 2-percent emulsion in the 2-percent solution of sodium carbonate (decahydrate) in which such knives are boiled, does not interfere with sterilization, which is effected within 5 minutes for all organisms tested.

THE STERILIZATION OF CATARACT KNIVES IN THE PRESENCE OF AC.10.

	Stab culture	Nutrient Agar				Heated Blood Agar	
		Staph. albus	Staph. aureus	Bact. coli	B. subtilis with spores	Str. pyogenes	Pneumococcus
Sterilizing experiment: Emulsion at boiling point	Initial	+	+	+	+	+	0
	Final	0	0	0	0	0	0
Control experiment: Cold emulsion	Initial	+	+	+	+	+	0
	Final	+	+	+	+	0	0

+ = Growth.
0 = No growth.

Two further lines of investigation were followed, being suggested by the aforementioned results, which are here only briefly reported:

(1) The rate of destruction of B. subtilis spores in the emulsion of AC.10 in sodium-carbonate solution at its boiling point and in the separate constituents of the emulsion.

It was found that the spores of B. subtilis, a proportion of which will retain their vitality after boiling in water for 10 minutes, are rapidly destroyed in the emulsion at boiling point, 5 minutes being adequate to attain sterility. The presence of sodium carbonate was essential to the destructive effect of the emulsion.

(2) The bactericidal action of AC.10 emulsions for Str. pyogenes and the pneumococcus. AC.10 as a 2-percent emulsion in distilled water is markedly bactericidal for the pneumococcus; less so for Str. pyogenes, and has no comparable action on Staph. albus or aureus, Bact. coli or B. subtilis. Bactericidal action is in-

BIOLOGIC REACTIONS OF AC.10. Professor Passey (Department of Experimental Pathology and Cancer Research, University of Leeds) arranged facilities for intensive instillation in the conjunctival sacs of rabbits for two weeks with a negative result, and added that the dilution and time factors would invalidate any remote effect from the irritant substances occasionally present in petroleum.

In 120 eye operations, including 25 cataracts, which have been carried out successfully by this method since November, 1944, there has been no reaction.

STERILIZER DESIGN. If the surgeon trying the method is disconcerted by the slight greasiness of the instruments, a separate compartment can be made in the sterilizer for AC.10 emulsion (for knives and keratomes only, in a small tray). One rub with sterile gauze brings all except molecular film off the handles, and a touch removes any excess from the blade. If the slight greasiness causes no incon-

venience, or if there is time to rub each instrument separately, all can be sterilized together in existing sterilizers. Trays with a locking bar to hold instruments in order of use, and to serve simultaneously as lifting fulcrum, are made to the design of one of us (J. F.) for both methods by Thackrays of Leeds.

An artery in the canal of Schlemm

Mr. Eugene Wolff in describing this vessel said that it lay toward the posterior (the scleral-spur end) of the canal of Schlemm.

It has a well-developed muscularis and is, therefore, an artery. It is some 60μ in diameter and contains red cells, whereas the canal on either side of it appears empty.

The artery is surrounded by loose connective tissue which is not sclera, for its texture and staining properties are different. It stains, in fact, like that tissue which is normally found in varying quantity between the endothelium of the canal of Schlemm and the sclera.

Superficially, this tissue meets the sclera, while on its deep surface it is continuous with the spongework of the ligamentum pectinatum.

The artery, therefore, lies in the canal and not in a partition between two portions of it. This may or may not be of purely histologic interest. Followed in serial sections, the artery is found to come from the anterior ciliary arteries. It is part of a circular vessel which runs parallel with the canal.

Maggiori, in his classical article, was the first to describe arteries as occurring normally in the immediate neighborhood of the canal of Schlemm. This has been confirmed by Theobald and others. Maggiori figures a circular artery running close to, and parallel with, the canal, and some of his illustrations appear to show an artery actually in the canal.

The finding of an artery in the canal of Schlemm, therefore, should cause no surprise. It might quite well be that, if the huge work of cutting complete serial sections were undertaken, an artery might be found in some portion of the canal in every globe. In any case, it is part of the circular artery figured by Maggiori.

As to the significance of an arterial system of vessels in close relation to the canal of Schlemm, it seems probable that they may exist, since the sclera itself requires very little nourishment, for supplying those afferents to the canal to which Friedenwald has lately drawn attention.

The artery here described was found during the routine examination of sections of an eye removed for malignant melanoma of the iris, which, however, had nothing to do with its presence.

The effect of aluminum and its alloys on human and rabbit eyes. A synopsis

Mr. L. H. Savin said that his interest in the subject was aroused by seeing, among the Dunkirk wounded, a number of eyes in which aluminum-alloy fragments were embedded. He followed for three years the case of a young sergeant in whose only eye a fragment of aluminum zinc lay in the retina. The metal was at first bright and silvery. Later, it became coated with a white cover of hydroxide. The fragment shifted twice, each time leaving a retinal "imprint," before eventually disintegrating into white powder. A second case behaved similarly.

Thirty-one implantations of aluminum and alloy fragments were made into the anterior chambers of rabbits by a standardized technique; and 10 vitreous-chamber implantations. There was no clinical difference in the behavior of pure alumi-

num and various alloys tried in doses varying from 0.3 mg. to 20.0 mg.

The fragments were observed to become coated with white powder, with a yellowish exudate, with fibrin, or in late cases with jelly. A late change often seen was powdering and fragmentation of the metallic fragment. In six cases, the fragment was completely absorbed.

Common local changes were necrotic "imprints" left by the metal; of these, 6 imprints were corneal, 12 on the iris (9 gray, 2 white, 1 necrotic), 2 in the lens, 4 in the fundus.

General effects on the eye included lens opacities in 28 eyes. Types of opacity included striae in 13 cases, dots or vacuoles in 10, irregular opacities in 10, and 4 cases with polychromatic luster. The situation might vary: 5 anterior-capsule instances; 6 anterior-cortical, 2 capsular imprints, 3 complete cataracts, 4 posterior-cortical.

Quiet inflammatory changes in the uveal tract were frequent. There were: 10 posterior synechiae, 2 cases of iris bombé, and 14 cases of iris atrophy.

Other changes included pathologic fundus pigmentation in 23 instances, 6 cases of localized choroiditis, 3 of retinitis proliferans. In order to obtain standardization of fundi initially, a special chinchilla-rex cross was bred. Partial coloboma of the choroid was not uncommon in rabbits.

Pathologic vascularization occurred often; there were not enough controls to decide whether the reaction was specific for aluminum.

Among other oddities were noted 2 cases of bullous keratitis, 1 staphylomatous eye (false buphthalmos), 2 cases of zonular keratitis, 1 interstitial keratitis, 1 deep keratitis, 2 pigmented corneas, 1 pigmented limbus, 2 folds in Descemet's membrane. These were interesting but statistically unimportant.

Histologic changes were mostly what would be expected from the clinical appearances. Attempts were being made to trace the aluminum through the tissues by special dyes.

Altogether it was definite that aluminum was by no means inert as supposed by some previous observers. In these cases, the experimental fragments had been probably left insufficiently long.

Dacryocystorhinostomy: A Simplified Method

Mr. T. M. Tyrrell presented this subject and illustrated his talk by a moving-picture film. He said that the main points of the operation were: (1) The incision was a long one to give a good exposure. (2) The operator attempted to remove the lacrimal bone in one piece by three blows with the hammer and chisel. (3) No attempt was made, as in other operations of this nature, to preserve the nasal mucosa, as it was not used in this operation to make the anastomosis. (4) The patency of the anastomosis was assured by repeated syringing over a long period.

Mr. Tyrrell did not wish to advocate this as a superior operation to those already practiced, but wished to point out that it had the great advantage of speed, as it could be done easily in 10 minutes, provided that one used some form of sucker to control the bleeding.

The anesthesia was 5-percent novocaine with adrenalin for the skin and tissues down to and including the periosteum. For the nasal mucosa, the nose was first sprayed with 20-percent cocaine and then a pledget of wool on an orange stick was pushed up the nose armed with cocaine and adrenalin paste.

LOS ANGELES SOCIETY FOR OPHTHALMOLOGY AND OTOLARYNGOLOGY

SECTION ON OPHTHALMOLOGY

May 28, 1945

DR. A. RAY IRVINE, *chairman*

SYMPOSIUM ON CONGENITAL ANOMALIES OF THE EYE FOLLOWING RUBELLA

Dr. A. Ray Irvine opened the symposium by stating that, due to recent articles in the literature, a new interest had arisen concerning congenital cataracts. He stated that he and his fellow staff members of the Children's Hospital were conducting the symposium for the purpose of advancing their information on the subject.

Dr. John P. Lordan stated that he began to realize the existence of this syndrome 18 months ago. He said that since Dr. Albaugh had recently written a paper on this subject, perhaps it would be better for him to summarize the problem before the discussion began.

Dr. C. H. Albaugh summarized the material available at the Children's Hospital.

Dr. A. Ray Irvine opened the discussion by bringing out the differences in type of cataract. He had seen approximately six to date. Two of these were also associated with buphthalmos and all of them with congenital heart disease.

Dr. Henry of Pasadena brought up the subject of abuse of the theory that abortion should be induced in young mothers who are known to have had rubella in the first few weeks of pregnancy. He felt that many might present themselves and state that they had had rubella merely in order to have their pregnancy terminated.

Dr. John P. Lordan suggested that the Section should bring up material and summarize it; then send such material to the Governor of the State of California, with the view to specific legislation.

Dr. A. Ray Irvine said that he agreed it might be advisable, but that the consensus seemed to be that we should know more about the disease syndrome.

Dr. Sidney Brownsberger discussed the use of convalescent serum. He felt that, in as much as it works in measles, it might well be of value here.

Dr. Albaugh agreed with Dr. Brownsberger that it might be advisable, but he felt that in a great many instances women do not realize they are pregnant until it is too late to give such serum; moreover, specific convalescent serum would be available only in large centers where there are communicable-disease hospital units.

Dr. Jeancon said that in her experience only 50 percent of women who had had rubella in the early stages of pregnancy gave birth to babies with congenital cataract.

Dr. Walter Roberts of Los Angeles asked Dr. Jeancon about the available statistics from Australia, which indicate that 100 percent of the women who have rubella in the first two months will give birth to babies with congenital cataracts and other congenital anomalies. He stated, however, that he had seen one case in which a woman was proved to have had rubella, but the infant was born normal.

Dr. Irvine brought up the question as to why these babies get cataracts.

Dr. Alfred Robbins, in turn, asked whether this disease really is rubella. He discussed the embryology of the lens and showed slides indicating the various stages of its development during the first few week of embryonic life. He considered that any disease in early pregnancy may cause such congenital anomalies in the eye, and urged caution in making any resolutions officially, saying that there is plenty of time to observe this syndrome to determine what its true nature really is.

Dr. Dennis Smith of Long Beach stated that he believed this to be another manifestation of an ectodermal disease.

Dr. Alexander Ray Irvine, Jr., asked why other diseases might not as well cause congenital cataracts. He discussed the relationship between rubella and fibroplasia, and stated that this also fitted in with the congenital heart lesions.

Dr. Albaugh asked why some of the patients do not have all the manifestations; that is, all the congenital anomalies. He wondered why some had heart disease, some had congenital cataracts, and some might have both, while still others might be deaf mutes.

Dr. John P. Lordan, in reply to the question, what are the differential points concerning the lens in the absence of a history of rubella in such types of cataract, said that a nuclear cataract with a typical complication, such as heart disease and deaf-mutism, is the answer.

Dr. Robbins stated that he was not so sure of the diagnosis; that he had seen four such cases, none with identical pathologic changes in the lens.

Dr. A. Ray Irvine reported a case from his practice in which there was a definite cortical cataract which was similar to a traumatic one.

Dr. Dennis Smith related the case of one of his patients who had been a premature infant and whose mother had had rubella in the early weeks of pregnancy. There were typical signs, such as cortical opacity and cloudiness of the cornea with congenital heart disease. He stated that at first the anterior chambers were not shallow; that the corneal opacity cleared. Later the whole lens became opaque and the cornea became edematous. Congenital glaucoma followed several weeks later.

Dr. John P. Lordan discussed his ideas of the therapy of such cases. He stated that, in the first place, these infants were supposed to be more atropine sensitive than are normal children. He felt that this was not the case—it was simply over-dosage and not a specific sensitivity. Most of these babies, he said, are underdeveloped and will not tolerate so much atropine as the normal child. On the whole, he thought that little could be gained by very early surgery because the pupil could not be dilated well.

Dr. Robert A. Norene stated that he had never had any difficulty with dilating the pupils in these patients, but that he had not used atropine. He found that neosynephrin was efficacious. He cautioned that it should be used carefully, in as much as the babies who had associated congenital heart disease might react excessively to a cardiac stimulant.

Dr. Warren Wilson stated that the diagnosis of rubella could be very easily overlooked. He discussed an epidemic he had seen, in which the cases were diagnosed as sore throat for some time before it was realized that it was an epidemic of true rubella. He said many of these patients go first to the Ear, Nose and Throat Clinic and are missed as rubella.

Dr. Welch of Glendale suggested that everyone be inoculated with both measles and German measles in childhood.

Dr. Dennis Smith wished to know about the optimum time for surgical intervention.

Dr. Mel Trainor stated that he always operated in these cases within the first year, and, if a needling was not done, he performed an optical iridectomy in order to give stimulation for development of the macula.

It was the consensus of the members of the staff that early operation is indicated in order to develop the macula properly.

Dr. Alfred Robbins stated that he operates as soon as possible. He also reported that the pupil dilates well with neosynephrin. He uses a special technique of his own in which he opens the anterior capsule of the lens and sucks out the corti-

cal and nuclear material with a special device of his own design. However, he is cautious about surgery from the standpoint of an anesthetic. He always waits until the pediatrician indicates that the child is in condition to stand general anesthesia.

Dr. John Lordan initiated a discussion of other congenital defects following rubella in early pregnancy. Among others, he had had several cases of buphthalmos. He felt that the mechanism was somewhat as follows: if the tissues around the angle are disturbed in early pregnancy by the process involved in rubella, the normal atrophy which leaves the trabecular network cannot take place, with the result that the canal of Schlemm and its mechanism are not developed. He believes that the procedure of Barkan—namely, anterior sclerotomy or goniotomy—is the indicated surgery.

Dr. A. Ray Irvine agreed with him and stated that he felt Dr. Barkan's results were 40 to 50 percent cures.

Dr. Endres stated that in his opinion it was economically impossible to send many of these cases to Dr. Barkan in San Francisco and that someone in Los Angeles should cultivate such a technique.

C. H. Albaugh,
Reporter.

MEMPHIS SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

June 19, 1945

Dr. M. B. Seligstein, *presiding*

Congenital stenosis treated by plastic dacryorhinostomy

Dr. Ralph O. Rychener reported on Larry G., aged two years, who was first seen on December 18, 1942. Congenital stenosis of both eyes, had been observed soon after birth, but treatment was delayed until June, 1941. Two months later fluid passed through the right duct and this eye gave no further trouble. However, stenosis persisted on the left side, despite 80 probings by a local colleague. On inspection, a large mucocele was found in the left sac with no evidence of infection. A double-0 probe was passed into the canal, an imperforate lumen ruptured, and fluid then passed freely into the nose. The duct remained open for a week, but, following an acute rhinitis, obstruction developed, and it was not possible to reopen the lacrimal passage thereafter. On June 19, 1943, a plastic dacryorhinostomy was accomplished, with permanent relief of symptoms.

Dr. Ralph O. Rychener reported a second case of congenital stenosis for which dacryorhinostomy was performed. F. C., aged five years, was referred to him on February 4, 1942, by Dr. A. D. Frost of Columbus, Ohio. Congenital stenosis was noted early, but treatment was not instituted until the child was 21 months old, when probing with the giant probe, after slitting of the canaliculi, was done. Although fluid could be forced through the passage into the nose, retention mucoceles persisted, and there was a constant lacrimation and backwash of purulent material into the conjunctival cul-de-sac.

Mucoid material could be regurgitated by pressure over the lacrimal sacs, and injection of iodochloral showed by X ray that the sacs measured 3 by 6 mm. and 5 by 10 mm., respectively. Fluid could be passed through the right sac under moderate pressure.

Under ether anesthesia, plastic dacryorhinostomy was done on the right sac, on February 11, 1942, and on the left sac, February 14th. The first operation was uncomplicated, but the second involved a cavernous plexus in the lacrimal fossa, resembling a hemangioma from which

there was considerable loss of blood. It was also necessary to extenterate some accessory ethmoid cells before the nasal mucosa could be reached. Glucose—175 c.c of a 5-percent solution—was given intravenously. Postoperative convalescence was uneventful. Fluid passed freely through both sacs by the sixth postoperative day. A letter from the parents on December 18, 1943, reported that both eyes were dry and giving no further trouble.

Pigmentary degeneration of the retina with cataracts and deafness

Dr. Philip Meriwether Lewis presented a white woman, aged 38 years, who had noticed for two years that her vision was failing.

Examination showed corrected vision to be: O.D. 10/200 and J10; O.S. 20/100 and J8. Immature nuclear cataracts were present in both eyes, but the visual fields were badly contracted, and the projection of light faulty. On dilating the pupil, an atypical form of pigmentary degeneration was found. The patient was also quite deaf and had been all of her life. She has two normal children, a boy of 11 and a girl of 9 years. During a pregnancy, two years before, she thought that her vision became much worse. This child lived only a few months. The cause of death was unknown. The patient's general condition and blood were normal.

Three other members of her family were examined. One brother and one sister, aged 45 and 43 years, respectively, had pigmentary degeneration of both eyes and also deafness. One sister, aged 49 years, had normal eyes and good hearing. One brother, aged 41 years, lived too far away to be examined, but was reputedly normal. The parents had been killed simultaneously by accident in their middle fifties. Both had had good sight and hearing; they were not related.

The question in this case was whether or not to remove the cataracts. In view of the bad prognosis and the likelihood of complete blindness eventually, it was thought that operation was contraindicated as long as the patient had any useful vision.

AMERICAN JOURNAL OF OPHTHALMOLOGY

Published Monthly by the Ophthalmic Publishing Company

EDITORIAL STAFF

DERRICK VAIL, *Editor-in-Chief*
55 East Washington Street, Chicago 2
WILLIAM H. CRISP, *Consulting Editor*
530 Metropolitan Building, Denver 2
LAWRENCE T. POST, *Consulting Editor*
640 South Kingshighway, Saint Louis 10
WILLIAM L. BENEDICT
The Mayo Clinic, Rochester, Minnesota
FREDERICK C. CORDES
384 Post Street, San Francisco 8
SIR STEWART DUKE-ELDER, BRIG.
63 Harley Street, London, W.1
EDWIN B. DUNPHY
243 Charles St., Boston
HARRY S. GRADLE
58 East Washington Street, Chicago 2
F. HERBERT HAESSLER
324 East Wisconsin Avenue, Milwaukee 2
S. RODMAN IRVINE
9730 Wilshire Boulevard, Beverly Hills, California
DONALD J. LYLE
904 Carew Tower, Cincinnati 2
IDA MANN
The Eye Hospital, Oxford, England
DR. RALPH H. MILLER
509 Union Central Building, Cincinnati 2
ALGERNON B. REESE
73 East Seventy-first Street, New York 21
M. URIBE TRONCOSO
500 West End Avenue, New York 24
F. E. WOODRUFF
824 Metropolitan Building, Saint Louis 3
ALAN C. WOODS
Johns Hopkins Hospital, Baltimore 5

EMMA S. BUSS, *Manuscript Editor*, 121 Woodbine Avenue, Wilmette, Illinois
KATHERINE FERGUSON CHALKLEY, *Assistant Manuscript Editor*, Lake Geneva, Wisconsin

Directors: LAWRENCE T. POST, President; WILLIAM L. BENEDICT, Vice-President; DONALD J. LYLE, Secretary and Treasurer; WILLIAM H. CRISP, HARRY S. GRADLE, DERRICK VAIL.

Address original papers, other scientific communications including correspondence also books for review to *Dr. Derrick Vail, 55 East Washington Street, Chicago 2, Illinois;* Society Proceedings to Miss Emma S. Buss, 121 Woodbine Avenue, Wilmette, Illinois. Manuscripts should be *original copies,* typed in *double space,* with wide margins.

Exchange copies of medical journals should be sent to *Dr. F. Herbert Haessler, 324 E. Wisconsin Avenue, Milwaukee 2, Wisconsin.*

Subscriptions, applications for single copies, notices of changes of address, and communications with reference to advertising should be addressed to the *Manager of Subscriptions and Advertising, 837 Carew Tower, Cincinnati 2, Ohio.* Copy of advertisements must be sent to the manager by the fifteenth of the month preceding its appearance.

Author's proofs should be corrected and returned within forty-eight hours to the *Manuscript Editor, Miss Emma S. Buss, 121 Woodbine Avenue, Wilmette, Illinois.* Twenty-five reprints of each article will be supplied to the author without charge. Additional reprints may be obtained from the printer, the George Banta Publishing Company, 450-458 Ahnaip Street, Menasha, Wisconsin, if ordered at the time proofs are returned. But reprints to contain colored plates must be ordered when the article is accepted.

NATIONALIZED OPHTHALMOLOGY IN BRITAIN

The Labor Government in Britain has been in power a little over nine months and is now in the throes of giving birth to the National Health Service Bill; and, although it is not yet law, it is already clear what the general outline of the new socialized medicine will be. For better or for worse, the whole aspect of British medicine is to change. No one who knows it and its shortcomings, particularly in the rural areas, will deny that many changes would be desirable. It may be of interest to American readers to know what is contemplated, for—who knows?—a similar fate may some day descend upon them.

From the point of view of the people, all medical facilities, both hospital services and personal medical attention, are to be offered "free" to any citizen who wishes to avail himself of them—that is, free to the sick person at the time, and paid for as a national charge, partly from a universally levied weekly insurance and

partly from general treasury funds. Incidentally, the insurance also provides birth allowance, children's allowance, sickness allowance, unemployment allowance, old-age pension, and provision for funeral expenses.

In general terms, from the administrative point of view, medicine is considered in two parts: the general-practitioner service and the hospital and specialist service; into the latter comes ophthalmology. All the hospitals of the country are to be taken over by the State, and the country is to be divided into some 16 or 20 regions, each of which is centered upon a university teaching school. Each of these regions is to be administered by a regional hospital board appointed by the Minister of Health, and their function is to coördinate and administer the specialist services in its area and lay down general lines of policy, the day-to-day administration of individual hospitals or groups of hospitals being delegated to local committees appointed by them. It is proposed to have a full and regionally planned hospital and specialist service available throughout the entire country: each hospital, whether rural or urban, whether previously wealthy or poor, will have comparable material facilities and comparable financial resources. Although they must conform to the general plan of hospital services designed by the regional boards, the teaching hospitals are to be allowed to retain a certain degree of individuality, since they are to be administered by separate boards of governors and may individually retain their endowment funds.

Ophthalmologists, as other specialists participating in the National Service, will thus be appointed by and in the employment of the regional boards (or the boards of governors of teaching hospitals). The whole of the practice of ophthalmology is to be institutionalized. Consulting and operating work will take place in the hospitals. The routine eye-testing and the provision of spectacles must, for obvious reasons, be more fully disseminated among the population, and these are therefore to take place not only in the hospitals but also in a large number of satellite clinics administered by them, functioning on a whole-time or part-time basis, depending on the needs of the locality. These clinics are to be staffed by an ophthalmic specialist, junior ophthalmologists under him (in the larger clinics), and, also under him, optometrists (sight-testing opticians) will do the bulk of the refractions. Spectacles will be obtainable ("free") at the clinic or at the shops of dispensing opticians who contract in to the service, but if they are broken or lost as the result of carelessness or if the patient chooses to be supplied with more expensive spectacles than those issued by the State, he will be expected to meet the additional cost involved. Until the clinic system becomes materially possible (and this in many districts will take some considerable time owing to lack of suitable buildings), as an interim measure the present system will virtually be carried on—patients will have a free choice of going without fee for refraction examination either to an ophthalmologist (at a clinic or his office) or an optometrist (at his shop).

A feature of the scheme of peculiar interest is the new relationship contemplated between ophthalmologists and opticians. It is quite obvious that in no measurable time could all the refraction work be done by medical men: no ophthalmologist in Britain today is idle, and yet some 75 percent of the refractions in the country are done by optometrists, and a universally "free" service will undoubtedly increase the demand very materially. Furthermore, it would not be economic that 10 years of training (the time which

will probably be demanded for the total training of a specialist) should be required for the routine examination of the optical state of all eyes, the vast majority of which are free from pathologic change. The ultimate arrangement, whereby all optical examinations are conducted under medical control, appears to be the most adequate arrangement possible, the junior ophthalmologist, the optometrist, and the orthoptist being supervised by the surgeon in charge of the clinic. Initially, in order to avoid hardship, it is the government's intention to employ in this way all adequately qualified optometrists on a rota system if necessary; the suggestion is that new entrants to the profession, however, will be required to become either whole-time "refractionists" or whole-time "dispensing opticians" so far as the State service is concerned. In the past, there has probably been as little love lost between ophthalmologists and opticians in Britain as in America, but it may be that when both parties fall into an allotted role the animosities of the past will be lost in coöperation in the future.

Where will all these changes lead British medicine? That is a question which today is very difficult to answer, and the reply will almost certainly vary with the political leanings of the individual. It may be argued that it is wrong that the care of the poor when they are sick should depend on the charity of the rich, that this should fall as a duty upon the community as a whole, and that the voluntary system allows many to escape their social obligations. It is true that hospital services and specialist facilities should be organized over wide natural areas and not confined to the capricious boundaries of local government or conditioned by the attractions of wealth or social amenities. It is certainly true that in the poor community, or the wealthy, an equally complete and efficient hospital service should be readily available for all. Moreover, as wages and prices rise and medicine becomes increasingly loaded with complicated equipment, the voluntary hospital must look forward with anxiety to a future wherein gifts are limited by unprecedented taxation and legacies are rendered almost impossible by death duties of confiscatory dimensions.

There are certainly many arguments which are difficult to confute in favor of such a national service, and many good points in the proposals outlined in the bill. On the other hand, there is a deficit account, and those who have been brought up in the spirit of a voluntary hospital cannot but have many misgivings. Will the loss of the local interest and local responsibility which gave individuality and vitality to the voluntary hospital be compensated by increased efficiency in a huge bureaucratic mechanism directed from afar by government servants, with the inevitable lack of elasticity which this must entail even in the most gently guided State scheme? Is the wisdom, the capacity, or the humanity of the State so great as to outweigh personal intimacy and interest and to justify a State monopoly of hospitals? There may be a gain in the technical machinery and financial resources available to medicine, but, unless the treasury changes the habits of centuries, will this carry with it individual frustration and submergence in administrative regulations? Time will show. Those of us who have served in the army may be able to suggest an answer. The administrative success of the scheme will depend in very large measure on the amount of decentralization allowed, on the wisdom of the regional boards, and on the degree of local financial freedom permitted within the limits of a reasonable budget.

So far as the ophthalmologist is concerned he will, to the extent to which he

participates in the service, receive the security of a regular pay-packet from the beginning of his professional career and a pension at the end in exchange for the adventures of private practice with its risks and possibilities; he will be deprived of many opportunities of doing much without material reward, but will incidentally be less his own master than formerly. So far as medicine (and ophthalmology) is concerned the new plan will be good in the final assessment only in so far as it can continue to attract brilliant young men and reward them sufficiently, and only if they have ample opportunity for initiative and the full expression of their personalities; there are few glittering personalities without glittering rewards, and medicine will be in competition with other comparable professions which as yet are not nationalized and may provide more individual scope.

It is anticipated that the present bill will become law in the early fall and that the national service will start to function in the beginning of January, 1948. It will then be necessary for each practitioner to decide whether or not he will take part in the service, either whole time or part time; but it is difficult for the consultant not to be at least a part-time participant, since all hospital facilities will belong to the State. With the present relations between the public and the profession, private practice will undoubtedly continue so long as the present generation lives. Everyone pays education rates in England, yet many send their children to Eaton. But social ideas change, and with heavy social levies double payments become more difficult. Certainly the danger potentially exists of the gradual abolition of private practice and the ultimate development of a State monopoly of medicine: the avowed aim of the Labor Party is a full-time State-salaried service "when the time is ripe." With State control of all hospitals, such a development would be easy, and very wide powers are to be vested in the Minister of Health—whoever he may happen for political reasons to be. This, accompanied as it would be by the greatest black market of all time, would, I think, be a tragedy for British medicine. As a whole, doctors today have the interests of medicine at heart; but whether the type of man who will be attracted to a State service in the future will be equally enthusiastic is another matter. On this will depend in part the ultimate success of this social experiment. In part it will also depend, unfortunately, on factors quite outside the control of medicine which hitherto have not always been uniformly dependable—on the wisdom of politicians and the understanding of civil servants.

Sir Stewart Duke-Elder.

OPHTHALMOLOGY SCORES AGAIN

It is a matter of common knowledge that ophthalmologists are modest, retiring fellows, and loath to praise themselves. This commendable trait can be overdone. Thus, no one has seen fit to applaud the course just launched by the Ophthalmological Study Council, so it falls to us to commend this last achievement of our specialty.

We are not alone in the emergency that instigated this project. All the medical specialties were faced with a 5-years' supply of candidates for special training disgorged by the Armed Forces. In ophthalmology there were opportunities to accommodate less than the normal quota of men for a single year. Their preparation falls roughly into three different categories: One group had had no special training, but was headed toward ophthalmology when taken into service; another had started special study, but was not

established in practice; a third was in practice before the war but wished for refresher courses. Most men in all groups were either contemplating the examinations for the certificate of the American Board of Ophthalmology, or had already tried them and been found wanting in some or all subjects. Consequently, they were desperately bombarding the Board with impatient letters inquiring into two problems. These were, first, how much credit the Board would allow for Army and Navy service. The reply to this was wholly unsatisfactory. The Board gave credit only for ophthalmologic experience so obtained. Because much of the service with the Armed Forces entailed no such experience, this led immediately to the second question, which was how the Board justified its position in establishing standards which could not possibly be attained by the great majority of the candidates under existing conditions.

While the Board was adamant as to the qualifications to be recognized as indicating competence in ophthalmology, they had to admit that there was some justice in this complaint. The Board itself does not intrude directly into the teaching field, beyond making every reasonable effort to stimulate existing teaching institutions. In this emergency the response was prompt and effective. The larger universities and hospitals readily agreed to increase their students and residents, often doubling and more than doubling the numbers. Many leaders in practice were willing to act as preceptors, especially for young men who had had residencies and basic courses. But after all these opportunities had been utilized, the Board was still swamped by applications of men who could obtain no places, most of them veterans who had made considerable sacrifice for the general good.

This was the situation when Prof. Ida Mann, who was guest of the American Ophthalmological Society at its Hot Springs session, in November, 1945, described the training course in use in England for men in service. It was a sort of mass production basic course. Pathology, to illustrate, was not administered to a few lucky students with microscopes, but was taught to large classes by throwing sections on the screen with a lantern.

This seemed to offer the logical solution to the problem, but, on proposing it, there were more reasons for delay than obstructed the invasion of France during the war. The very fact that the hospitals and schools had generously overextended themselves in this cause, prevented them from undertaking anything additional, especially such a novel experiment as this.

So at the end of the year the secretary of the Board was unexpectedly invited to a conference in Boston with Dr. Walter B. Lancaster and Dr. Theodore L. Terry. It was a carefully planned meeting, evidently not so impromptu as it seemed, and, somewhat to the surprise of all, it reached a decision to offer a course in the basic subjects of ophthalmology in Boston, during April and May of 1946. It was believed that if the course were to be of use it must proceed at once, and four months seemed the shortest time in which arrangements could be made. In view of the foreseen and unanticipated obstacles that were encountered, this interval was decidedly brief.

Now is a good time to answer the inquiries from colleagues contemplating a similar course, as well as from teachers in other specialties. The detail was enormous. Either because of it, or coincidentally, Doctor Terry fell by the wayside and was sent to the hospital, and then away to convalesce. Not, however, until he had made his contribution to the organizing. The work then fell upon Doctor Lan-

caster. Possibly the launching of the course on time was due to having a one-man committee able to make instant decisions. The result was that Doctor Lancaster was also laid up, just as the course began. Only the versatility of a few secretaries prevented a traffic jam on registration day.

Perhaps a brief review of the arrangements required will reduce the casualties among future organizers. Without attempting a blow-by-blow report, one may say that these are the main headaches. First, where would such a course, having no hospital or medical-school backing, be given. At this time, the venture did not even have the renowned shoestring, which has so often brought success. Fortunately, the hall of the Boston Medical Library was available, and the managers made no embarrassing inquiries about the solvency of the course. Then, many of the local teachers, who would normally have been asked to teach, were already under contract to the extra session of the 4-months' basic course which the Harvard Graduate School of Medicine had organized in response to the pleas of the Board. So faculty must be in considerable part imported. This seemed at first likely to be as difficult as getting nylon stockings, but it turned out to be the least of our troubles. No one refused. The finances required much more maneuvering. The obvious source of support was the Veterans' Administration appropriation under the G.I. Bill of Rights. The authorities, however, were canny, and required unshakable proof that the G.I. was not going to be swindled by either shysters or visionaries. If funds were to be authorized, incorporation and approval of the proper authorities of the Commonwealth of Massachusetts must first be forthcoming. So an imposing group of incorporators had to be enlisted. This offered no particular difficulty, but took much valuable time. Further confidence was built up by inviting an advisory board of outstanding teachers.

An unexpected problem arose in the housing and nourishment of a large group like this. At that time, Boston doctors were unable to obtain rooms for single patients who wished to consult them. The hotel association could not promise any accommodations for such an indefinite number of men, many with families. They did, nevertheless, find a summer hotel some 20 miles out, which was willing to open a couple of months early, and offered reasonable rates. This method required a bus service to get the students to and from classes, and their wives to and from stores.

In the meantime a curriculum had to be determined, hours assigned, and teachers fitted to the hours, or hours to the teachers. With many of the most illustrious faculty as far away as Baltimore and Chicago, this would have made a complicated job even for a veteran train dispatcher. It was decided to hold sessions morning, afternoon, and evening. While this seems to exceed union hours, in practice it was not too arduous. Lectures were limited to five or six a day. Considerable rest periods, quizzes, and examinations were interspersed. Usually the week ended Saturday noon.

One problem common to all such courses is as unsolvable as uniting the United Nations. That is adapting such instruction perfectly to the needs of such diverse groups, one of which had never had any ophthalmology; another with considerable knowledge of the fundamentals; and a third with a varying amount of actual practice. To complicate this situation still further, textbooks were entirely unavailable, and would not be issued until sometime in the summer. Thus more textbook material would have to be repeated in the lectures than would usually

have been the case. This necessitated some method of reproducing the lectures of those instructors who spoke without notes. Stenotypy, which has been used in some refresher courses, was too expensive. Ediphone equipment was therefore purchased, and hooked up with the broadcasting apparatus in the hall. This necessitated obtaining secretaries to transcribe the records, no mean task with the shortage.

The result of this hastily organized project was better than could have been supposed. That some "bugs" would creep into such a novel scheme is inevitable. They were not always the ones that were foreseen. New England weather had to live up to its reputation. An untimely blizzard hit the area in April, to extend its welcome. Consequently the men on reaching their hotel on registration day found their families almost rigid with cold in an inadequately heated summer hotel. Many at once sought quarters in Boston though not always what they would have chosen. Then, in response to questionnaires, it seems that more concentration in the daytime, and no lectures in the evening would have been more popular. As would be expected, beginners felt that "too much was taken for granted" and experienced men called some elementary work "sophomoric." Now that textbooks are again available, this last objection could be avoided in a later course.

At $200 for the course, the cost was about $25 a week, which is probably too little. It gave the organization, with between 75 and 100 students, an income of over $18,000, which just about covered expenses, allowing a modest recompense to the lecturers.

The general attitude was favorable. In fact the demand for a repetition is such that a similar course is projected in Florida during November and December. This does not necessarily mean that it will become a permanent institution. It was planned as an emergency measure to meet the immediate need, in which, as usual, ophthalmology has pioneered.

S. Judd Beach.

IRIDENCLEISIS AND TENON'S CAPSULE

Almost forty years ago Holth of Christiania (now Oslo) published what must be regarded as one of the classics of ophthalmic literature, under the title of "Iridencleisis antiglaucomatosa" (Annales d'Oculistique, 1907, volume 137, page 345; originally presented in 1906 to the Medical Society of Christiania; also in condensed form to the French Ophthalmological Society and to the German Ophthalmological Society in Heidelberg). Holth's paper is a model of clear thinking and patient observation.

Except as to iridectomy, proposed by Graefe for the relief of glaucoma fifty years earlier, previous operations against glaucoma had aimed to establish a new channel of drainage of aqueous humor by excision of sclera beneath a conjunctival flap. Holth's operation, generally speaking, excises no tissue; and it depends for a successful result upon the formation of a new drainage channel associated with incarceration of the pigmented iris between the lips of the scleral wound.

Two or three years before publication of Holth's paper, the study of glaucoma had taken a great step forward with the introduction of the successful tonometer of Schiötz, another Christiania leader. Holth had tested with the tonometer a series of glaucomatous eyes which had been subjected to iridectomy. Except within the first few weeks after the operation, he found the intraocular pressure generally above normal. Strangely enough, and in spite of the dread of iris

prolapse as a dangerous complication following any intraocular operation, Holth learned that the iridectomized eyes which had been relieved of their hypertension were usually eyes in which the technique of the operation had been regarded as defective in that iris tissue had been left in the scleral wound.

Holth therefore made an intentional experiment upon the two equally hypertensive eyes of the same patient (54 mm. Schiötz), doing an ordinary iridectomy upon the blind eye and on the other eye an iridectomy with incarceration of the iris beneath the conjunctival flap. In the former the tension fell to 43 mm., in the latter to 24 mm. Comparison of other cases of accidental incarceration with cases in which the iridectomy had been classically performed supported the conclusion that the subconjunctival incarceration was beneficial instead of harmful. Holth therefore proceeded in a number of cases to perform iridectomy with intentional incarceration, and his original article reported a goodly series of excellent results.

The technique of iridencleisis has undergone various modifications at the hands of different surgeons. Holth himself preferred a keratome incision, picking up an 8- or 10-mm. conjunctival flap, pushing the keratome along the sclera to within a bare millimeter of the limbus, and then drawing the iris sphincter into the scleral wound and making a meridional cut to one side of the forceps. Others have made the incision with the Graefe knife, although Holth had tried this method and did not favor it. Some surgeons have worked through a small conjunctival opening made with a Graefe knife. Occasionally, operators have dissected a conjunctival flap from the limbus peripherally (Van Lint flap). Some have performed the usual type of iridectomy, but leaving iris tissue in each angle of the scleral wound. Others have combined iris incarceration with excision of sclera as recommended by Lagrange.

Reese (Archives of Ophthalmology, 1945, volume 34, page 360) has lately urged the same type of keratome approach as originally advised by Holth; succeeded by the making of traction on the pupillary margin at two points (by operator and assistant synchronously) until a dialysis is produced between the two points of traction; and lastly division of the iris at right angles to the pupillary margin, followed by incarceration of each pillar of the iris into an angle of the wound.

Approval or disapproval of the iridencleisis operation by the individual operator seems to have varied greatly according to his previous preference for other operations (the Lagrange or the Elliot especially), or according to the custom of surgeons in the same part of the world. No doubt an important influence has come from initial experience in performance of the operation, especially such experience as might depend upon misconception or preconception regarding technique of anesthesia or of the operation itself.

Downright opposition to the operation has been manifested by some surgeons. Torres Estrada (Mexico), for example, speaks very strongly against every fistulizing operation, and practically always performs a very extensive cyclodialysis to which he has applied the title "hemicyclodialysis" (Boletin del Hospital Oftalmologico de Nuestra Señora de la Luz, 1946, January-April, page 121). A few eye surgeons have had the misfortune to see one or two cases of sympathetic ophthalmia following filtration operations, including iridencleisis.

It maybe that, in discussing the technique of iridencleisis as well as the occasional failures following this operation,

we have paid too little attention to the anatomic and physiologic relations of Tenon's capsule. In describing the operation, reference is often rather loosely made to dissection through subconjunctival tissue down to the sclera in the vicinity of the limbus. Holth himself makes no direct statement in this regard. His insistence on use of the keratome rather than scissors in executing the preliminary incision may have a bearing on the subject, especially when considered in relation to his description of a keratome incision which penetrates the conjunctiva 8 or 10 mm. from the corneal margin, and then drags the conjunctival fold along the sclera to enter the eye a scant 1 mm. above the limbus.

Peters's chapter on diseases of the orbit in Axenfeld's Lehrbuch (seventh edition) regards the space between Tenon's capsule and the sclera as a lymph space which continues into the supravaginal lymph space of the optic nerve and is also connected with the suprachoroidal space of the eyeball. Some doubt has been cast upon the existence of such anatomic continuity.

In dissecting back a conjunctival flap for cataract operation, it is a matter of common note that the subconjunctival tissue (in Tenon's capsule) of this region varies greatly, being sometimes well defined as a special layer and sometimes less definite. But usually, after incising the conjunctiva, it is possible with care to pick up a delicate but distinct layer of fibrous tissue which may then be incised as a unit and so separated from the sclera as far as the limbus.

Meller, disapproving of iridencleisis on general principle, repeatedly avoided mentioning it in his "Ophthalmic surgery." Sweet's third American edition of the same work (from Meller's second edition) gives an account of the iridencleisis operation but makes no mention of Tenon's capsule in this connection. The same is true of Spaeth's "Ophthalmic surgery."

Many surgeons have approached consideration of the iridencleisis operation with a definite prejudice against it, and have never been converted from this prejudice. The present writer's experience with the operation (which he first used in December, 1928) has usually been gratifying, and he is disposed to believe that some failures have been, at least in part, due to insufficient care in separation of Tenon's capsule as an anatomic unit.

Holth's very definite success in applying this procedure to a number of cases of absolute glaucoma, with tension as high as between 60 and 70 mm. Schiötz (in spite of miotics) and also as a second operation after failure or incomplete success of iridectomy, has been shared by other operators. Use of iridencleisis after an acute exacerbation of chronic glaucoma should probably be resorted to only after beneficial reduction of tension by paracentesis.

W. H. Crisp.

BOOK NOTICE

CLINICAL OPHTHALMOSCOPY. By Arthur J. Bedell, M.D., F.A.C.S., D.Sc., LL.D. 200 glass mounted Kodachrome 2 by 2 inch reproductions with a concise history and a description of each. Distributed by James A. Glenn, 76 Columbia Street, Albany, New York. Price $100.00. 1946.

It has been a rare privilege and a great treat for the reviewer to be able to view these slides, leisurely projected as these were meant to be, where the full beauty and the remarkable stereoscopic illusion could be fully enjoyed. Each slide beautifully discloses details that minutely express the condition. Natural colors ar-

faithfully reproduced, enhanced by the expertly sharp focus. The series has been carefully chosen to illustrate most of the ocular-fundus conditions that are met with in ophthalmoscopy. The collection is of great value to the teacher and should be available to all students for study and review.

The collection begins logically enough with a few slides of the normal fundus and its variations. It progresses through various pathologic conditions, each of which is illustrated with two or more slides, to end with fine photographs of a "before and after" case of an intraocular foreign body.

There are many serial pictures of the same patients taken at different intervals, some over a period of several years. Thus an unusual opportunity is afforded to trace the evolution of different disease processes and to compare one phase with another. The instructive series of slides illustrating the various grades and stages of development of retinal arteriosclerosis, vascular hypertension, and diabetic retinopathy are especially noteworthy. Their value as teaching aids in explaining and understanding this difficult subject is obvious. Another example of the teaching value of interval pictures can be readily appreciated on viewing the series of macular retino-choroiditis up to the healed stages.

It is difficult to pick out the most outstanding photographs. All are good and many are worthy of exclamation. There are no failures and few disappointments. In some of the photographs the white spots, representing the reflex from the carbon arc, have been painted out. The author points out that these should not be misinterpreted as localized pigmentation, a very real danger. It is questionable whether any thing has been gained by obliterating the reflex, for the remnants are always visible. However, in one case, that of a photograph of a detached retina, the painting out of the carbon reflex has undoubtably enhanced the effectiveness of the slide. It is curious, too, not to see pigment deposits, for example those of retinitis pigmentosa, stand out as black as they do in life. But these are exceedingly minor flaws and are not worthy of being dwelt upon.

It is unnecessary to explain to the reader who Dr. Bedell is. His fame as an ophthalmologist and photographer of the ocular fundus is world wide. Those who have not had the chance to hear him and see his pictures at the meetings for the past many years now have access to an unsurpassed collection of what are no doubt the prizes of his many years of work.

Now if some well-known ophthalmic pathologist will provide us with a similar set of Kodachrome slides that illustrate the pathology underlying each of the Bedell reproductions, the heart of the teacher will be exceedingly happy.

The Bedell Kodachrome slides are carefully mounted in glass, numbered, and distributed in two gray, metal slide boxes with handles. A good description of each slide, covering the essential points of history and condition, is printed and bound spirally between paper covers and accompanies the collection.

Derrick Vail.

CORRESPONDENCE

Postgraduate instruction in ophthalmology at Harvard Medical School

To the Editor,
American Journal of Ophthalmology:

In the May, 1946, number of the American Journal of Ophthalmology appears an excellent editorial by Dr. Crisp entitled "A national program for training

in ophthalmology." In commenting on the postgraduate courses given at Harvard, Dr. Crisp states, "These short programs should be stimulating to young ophthalmologists whose time was badly wasted during the war, and who are eagerly looking for refresher courses. By themselves, the two Harvard courses cannot, it is obvious, create first-class ophthalmologists."

With this I agree wholeheartedly, and lest anyone might infer from the editorial that it is the intention of the Department of Ophthalmology at Harvard to create ophthalmologists by short courses, I wish to state that just the opposite is true. These two courses were given earlier than usual, and in condensed form, to help fill the tremendous demand for instruction on the part of the returning medical officers, but they were designed primarily for young doctors wishing to take didactic work as a preliminary to their residency. Selection of candidates was carefully made on the basis of previous education and future intentions, and no one (except recognized ophthalmologists) was allowed to take the clinical course without first having had the course in fundamentals.

We believe that a residency in ophthalmology is the only proper way to obtain adequate training in this field, but that a course in the basic sciences should be a prerequisite to such a residency. This basic-science course is necessary to bridge the gap between the deficiencies of undergraduate medical-school training in ophthalmology and the clinical work in the residency.

We feel sure also that the fundamentals cannot be taught by lectures, reading, and quizzes alone, as some have contended. Laboratory work is essential, but it is questionable whether this type of basic instruction can be given properly by the average clinical ophthalmologist. In most instances it is better done by the full-time research staff attached to an ophthalmic center.

The policy of the Department of Ophthalmology of Harvard Medical School is to give two types of postgraduate instruction: (1) A basic-science course of three months' duration given by the staff of the Howe Laboratory of Ophthalmic Research to young physicians who are going to take a residency in ophthalmology. (2) Refresher courses in clinical subjects given by clinicians and open only to recognized ophthalmologists who have already had an ophthalmic residency.

(Signed) Edwin B. Dunphy, M.D.
Clinical Professor of Ophthalmology,
Harvard Medical School.

Dispensing with bifocals

Editor,
American Journal of Ophthalmology:

Apropos of Dr. Pascal's remarks on "Dispensing with bifocals" in the May, 1946, issue of the American Journal of Ophthalmology, it may be interesting to report a case which bears out the feasibility of so doing to even a greater extent, at least in selected cases.

While in Belgium, I had known and had some contact with Prof. Allvar Gullstrand, who was wearing bifocals in which each lens was adapted for two different distances for the corresponding eye; that is, the bifocals gave Dr. Gullstrand four monocular regions of clear vision with binocular fixation. This case illustrates what can be done along this line in providing two full monocular fields of vision with a pair of differently adapted single-vision lenses.

(Signed) Georges Kleefeld, M.D.
115 Central Park West,
New York, New York.

ABSTRACT DEPARTMENT

EDITED BY F. HERBERT HAESSLER, M.D.

Abstracts are classified under the divisions listed below, which broadly correspond to those formerly used in the Ophthalmic Year Book. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. General methods of diagnosis
2. Therapeutics and operations
3. Physiologic optics, refraction, and color vision
4. Ocular movements
5. Conjunctiva
6. Cornea and sclera
7. Uveal tract, sympathetic disease, and aqueous humor
8. Glaucoma and ocular tension
9. Crystalline lens
10. Retina and vitreous
11. Optic nerve and toxic amblyopias
12. Visual tracts and centers
13. Eyeball and orbit
14. Eyelids and lacrimal apparatus
15. Tumors
16. Injuries
17. Systemic diseases and parasites
18. Hygiene, sociology, education, and history
19. Anatomy, embryology, and comparative ophthalmology

4

OCULAR MOVEMENTS

Smart, R. E. **The diagnosis and treatment of ocular muscle anomalies,** Canadian Med. Assoc. Jour., 1946, v. 54, April, p. 371.

The author outlines the diagnostic procedure which he considers essential in the study of the functions of the extraocular muscles. It consists of six steps; namely,

(1) Measurement of the near point of convergence. (PcB)

(2) Maddox-rod test (with screening) at 20 feet, and at 14 inches. These first two tests are used to determine whether the anomaly is one of convergence or divergence, and if it is an excess or an insufficiency.

(3) Ocular excursions in the six cardinal directions.

(4) Screen comitance test in the cardinal directions.

(5) Cover test (with prisms) at 20 feet, and at 14 inches; then, in the cardinal positions at 14 inches. These three tests enable one to determine whether or not a heterophoria or heterotropia is concomitant; if it is not, they enable one to identify the paretic muscles involved.

(6) Accommodation is tested with Prince's rule.

In addition to these tests, vergence tests may be necessary. At times, a prolonged monocular occlusion is of value in eliciting a heterophoria.

The question of treatment of muscle anomalies is touched upon. Emphasis is placed on the need for an accurate muscle diagnosis in the proper care of the eye patient. Benjamin Milder.

Wincor, H. G. **Method of measuring and placing recession sutures.** Amer. Jour. Ophth., 1946, v. 29, May, pp. 585-587.

5

CONJUNCTIVA

Bietti, G. B. **Action of penicillin upon the inclusion bodies in trachoma.** Studi Sassarese, 1945, v. 23, no. 1, pp. 3-7.

Bietti studied the effect of penicillin

on inclusion bodies from 10 cases of recent trachoma, since this seemed the best test of the activity of the antibiotic upon the virus. Collyria containing 100 to 20,000 units per cubic centimeter were instilled every two hours. One eye only of each patient was treated, and smears were made daily from both eyes. Within 24 to 48 hours the corpuscles showed marked morphologic changes, and in 48 to 72 hours the initial bodies and the inclusion bodies had disappeared. The action of penicillin was not, however, more effective than that of the sulfonamides and did not clear up the nodules more rapidly. Eugene M. Blake.

Bietti, G., and Scalfi, L. **The sensitivity to penicillin *in vitro*, of typical conjunctival bacteria.** Studi Sassarese, 1945, v. 23, no. 1, pp. 3-4.

The writers isolated 51 cultures of nonliquefying Staphylococcus albus, 12 of liquefying Staphylococcus albus, 13 of Staphylococcus aureus, 34 of diplobacillus, 24 of B. xerosis, and 6 of Koch-Weeks bacilli. The organisms were grown in agar, broth, Loeffler's serum, and blood agar, to which penicillin had been added in concentrations of 0.01 to 5 Oxford units per cubic centimeter of culture medium. Staphylococcus was found most sensitive to the drug, with very little difference between the three types. Next in order was B. xerosis, then the Morax-Axenfeld diplobacillus. The Koch-Weeks bacillus was practically unaffected. The most striking result of the study was the fact that the diplobacillus, a gram-negative organism, was consistently sensitive to penicillin.

Eugene M. Blake.

Bietti, G. B., and Pegreffi, G. **The Weil-Felix reaction in keratoconjunctivitis epizoötica and in trachoma.** Boll. Soc. Ital. di Biol. Sper. 1942, v. 18-21, pp. 1-2.

Coles and others have found rickettsia in the epithelial scrapings from the conjunctiva of birds in a certain form of conjunctivitis. Since some observers have reported rickettsialike bodies in trachoma, the authors tested the blood of 45 patients suffering from trachoma, by the Weil-Felix test, and found the results to be negative.

Eugene M. Blake.

Bietti, G. B., and Scalfi, L. **Effects of penicillin in the conjunctival sac at various intervals after its instillation.** Studi Sassarese, 1945, v. 23, no. 1, pp. 1-6.

The author found that a solution containing 2,000 Oxford units per cubic centimeter instilled into the conjunctival sac every two to four hours was effective against all of the common pathogenic microörganisms of the conjunctiva. When the secretion is especially abundant and when more resistant organisms, such as Koch-Weeks and Pfeiffer bacilli, are present, more frequent use of stronger concentrations is required. Local application of penicillin in conjunctival disease is at least as effective as its intramuscular use.

Eugene M. Blake.

Davids, H. **Rössler's remarks on an article: "A contribution to therapy of trachoma."** Klin. M. f. Augenh., 1943, v. 109, Jan.-Feb., p. 107.

Davids defends himself against Rössler's accusation that he published his recommendation of treating trachoma with cold applications as a "new method of therapy" and also that he omitted to mention the treatment with albucid in the same article. The first publication concerning trachoma thera-

py with sulfa drugs came to Davids's knowledge after conclusion of his experiments with cold (ice, not carbon-dioxide snow) applications.

F. Nelson.

Khanolkar, V. R. **Bowen's disease of the conjunctiva.** Amer. Jour. Ophth., 1946, v. 29, May, pp. 515-519. (6 figures, references.)

Knapp, A. A. **The eye as a guide to latent nutritional deficiency diseases; a clinical study of ocular diseases at an advanced base hospital in the Southwest Pacific.** Bull. New York Acad. Med., 1946, v. 22, April, p. 217. (See section 17, Systemic diseases and parasites.)

Miller, C. D., and McIntyre, D. W. **A syndrome termed Reiter's disease (urethritis, conjunctivitis, and arthritis).** Ann. Int. Med., 1945, v. 23, Oct., p. 673.

"Reiter's disease" was not recognized as a clinical entity until 1916, when Reiter described a syndrome of urethritis, conjunctivitis, and arthritis which was nongonorrheal in nature.

This syndrome is a definite clinical entity of unknown cause, presumed to be infectious because of its clinical course. The possibility of its being a venereal disease is remote. The possibility that a virus is the etiologic factor is being investigated.

Complications are infrequent but may be very severe. The prognosis is usually good, but recurrences are noted in about one fourth of the patients. None have died.

Eye complications are infrequent. Episcleritis, iritis, and keratitis have been observed. The keratitis heals with scarring. Herpes of the conjunctiva and cornea have also been recorded.

It must be assumed that the incidence is more frequent than appears from the literature. Since the syndrome is little known, many cases are not properly diagnosed nor recognized.

Theodore M. Shapira.

Miterstein, B., and Stern, H. J. **Treatment of acute conjunctivitis and trachoma with sulfonamides.** The Lancet, 1945, May 26, p. 649.

The acute phase of Koch-Weeks conjunctivitis is described. If left untreated, it subsides in 6 to 8 weeks, but usually becomes chronic. In 13 patients, one eye was treated with silver nitrate, the other with a 5-percent ointment of Pyranil (a compound containing p-amino-phenyl-sulphonamide in addition to pyridine-dicarbonic acid anhydride). The results in 12 cases were equally good in both eyes. Treatment with both silver nitrate and Pyranil was more successful than treatment with either alone.

Sulfanilamide by mouth, 0.05 gm. per Kg. body-weight daily, was tried without effect. However, sulfapyridine by mouth, 0.05 gm. per Kg of body weight, produced dramatic improvement within 24 hours. In a few hours the bacilli showed pleomorphic changes, and became fewer in number. After 14 hours, smears were consistently negative. Cases were clinically cured in three to seven days. Local treatment was sometimes needed. Treatment was continued at least a week beyond the time of clinical cure to avoid relapse. Sulfapyridine applied locally had no effect.

Sulfanilamide, sulfapyridine, and pyranil have proved valuable in treating trachoma. The authors think Pyranil is the treatment of choice in cases associated with severe corneal complications.

Robert N. Shaffer.

Seefelder, R. **Conjunctival scar formation in vernal catarrh.** Klin. M. f. Augenh., 1943, v. 109, Jan.-Feb., p. 32.

It is generally accepted that vernal conjunctivitis heals without scar formation, although sometimes after many years scarring may develop. Saemisch, who was the first to describe the disease, noted in 1904 that the inflammatory process may eventually result in scar formation and atrophy. Seefelder reports the case of a man, 30 years of age, who had been under his observation for 16 years because of typical vernal conjunctivitis with eosinophilia in the blood and in the conjunctival secretion, and scar formation in the cornea. There was no trace of pannus and certainly no complicating trachoma. The tarsal conjunctiva became scarred throughout. The uniform reticular scarring, partly netlike, closely resembled trachoma. Biopsy specimen of tissue of hypertrophic conjunctival islands showed typical histologic features of conjunctivitis vernalis. F. Nelson.

White, J. P. **Haemorrhage from the conjunctiva. Notes on a case of capillary angioma.** Brit. Jour. Ophth., 1945, v. 29, Dec., pp. 635-637.

A case of capillary angioma on the palpebral conjunctiva of the right upper lid is reported. On two occasions the patient had suffered from bloody tears. A histologic examination of the tissue showed that the epithelium was reduced to a single row of cells where the capillaries reached it. It would appear therefore, that the angioma was the source of the hemorrhages reported by the patient. Edna M. Reynolds.

6

CORNEA AND SCLERA

Albanese, A. A. **Corneal vascularization in rats on a tryptophane-deficient diet.** Science, 1945, v. 101, June 15, p. 619.

It has been repeatedly reported that riboflavin deficiency produces corneal vascularization in rats. The author had noted corneal vascularization in rats placed on a tryptophane-deficient diet. He then fed a control group of nine rats a tryptophane-deficient diet. Another group of nine rats was given a similar diet to which an adequate amount of riboflavin had been added. Corneal vascularization and cataracts developed at exactly the same rate in the two groups. After five weeks both groups were fed the basic tryptophane-deficient diet without riboflavin but with added tryptophane. All rats rapidly gained in weight, the corneas recovered completely and the cataracts partly disappeared.

Recent reports of corneal vascularization in man which failed to respond to riboflavin therapy suggest the possibility of an exogenous or endogenous deficiency of tryptophane and the employment of tryptophane as a therapeutic measure. Robert N. Shaffer.

Babel, Jean. **The fate of corneal transplants.** Ophthalmologica, 1945, v. 109, Jan., pp. 1-18.

In spite of extensive research the changes in corneal transplants still are not satisfactorily explained. The author considers only autogenous grafts as heterogenous grafts never last long. They are eliminated and replaced by tissue that originates in the host.

The pertinent literature is reviewed in great detail, and reports of the author's own experience are added in detail, including clinical and histologic descriptions of such cases. Among sixty corneal transplants, two corneas were examined histologically. The preparations all came from eyes in which a

second transplant was necessary, chiefly because of increasing cloudiness of the first. The author believes that the results in his eyes, despite their lack of transparency, provide some material toward a better understanding of the mechanism and the outcome in corneal grafting. The transplanted corneas which were examined histologically had been in place for periods that varied between four days and five years.

The main corneal structures, the stroma, and Bowman's and Descemet's membranes remained intact within the graft. The epithelium might be unchanged or disorganized but was different from the epithelium of the host. A necrosis of the fixed and wandering cells took place; these were replaced by other cells of unknown origin. In case of inflammation or infection, vessels from the adjoining cornea or iris invaded the transplant, bringing connective tissue and nerves into the graft, and changing its structure. Its border always remained distinct. The clinical and experimental work led to the same conclusion that the original transplant survives. It does not explain the biologic and physico-chemical conditions which sometimes keep the transplant clear and sometimes not. It is essential that the borders of the wound in the host and the margins of the graft are sharply and smoothly cut and neatly adapted to each other so as to prevent the epithelium from proliferating and growing into the wound. A careful section of Descemet's membrane is also important because remains of this membrane might give rise to obstructiong layers of retrocorneal tissue. (15 tables, references.)

Alice R. Deutsch.

Berens, C. **Corneal punch for square and rectangular transplantations of cornea.** Arch. of Ophth., 1946, v. 35, Jan., p. 47.

When a rectangular implant is used in performing transplantations of the cornea, a protruding lip of cornea may remain posteriorly. This is especially likely to happen when the recipient cornea is thickened or edematous. The removal of this lip with instruments ordinarily available has been found most difficult. Berens describes a square corneal punch which he has devised to facilitate the procedure.

R. W. Danielson.

Blum, J. D. **The heredo-familial corneal degenerations and their relation to congenital corneal opacity.** (Clinical and genealogical study.) Ophthalmologica, 1945, v. 109, March, pp. 123-136.

The author recognizes the importance of Bueckler's paper, which brought order into the very confused nomenclature of the heredo-familial corneal dystrophies. He describes the three types of heredo-familial corneal degenerations which differ in their clinical appearance and pattern of inheritance and discusses their differentiation from other corneal abnormalities. He also reports the pedigree and clinical observations on patients with similar lesions under his care. In the discussion of differential diagnosis, luetic interstitial keratitis, epidemic keratoconjunctivitis, and corneal degeneration of Hurler's dysostosis are mentioned, and certain congenital corneal opacities are described in detail. Corneal opacities with ocular malformations, embryotoxon, and sclerophthalmia are not considered in this paper. He pays especial attention to a type of congenital corneal opacity which in its clinical picture closely resembles group 3 of Bueckler. Both lesions are familial and

recessive, they are bilateral, interstitial, denser in the center than in the periphery, with an intact epithelium and without any signs of inflammation or vascularization, and they cause considerable disturbance of vision. They differ from each other only in that the congenital opacities are present at birth and corneal dystrophies start during the first 10 years of life and progress steadily. The author reports the history, clinical appearance, and pedigree in two cases of congenital corneal opacity, and in five cases of corneal dystrophy group three. (2 pedigrees, references.) Alice R. Deutsch.

Claus, S. **Nevogenous pterygium.** Klin. M. f. Augenh., 1943, v. 109, Jan.-Feb., p. 59.

A man, 41 years of age had noticed a gradually increasing gray spot in his left eye. At the limbus at the 10-o'clock position, a flat, freely movable, pigmented nevus of the conjunctiva was found associated with a pterygium which extended slightly beyond the limbus. Because of possible malignancy, the whole structure was removed and examined histologically. It proved to be a genuine nonmalignant pigmented nevus and a typical pterygium. No cellular infiltration was found in the surrounding tissue. Apparently the pterygium originated directly from the adjacent nevus, the first case of its kind to be published. (References.)

F. Nelson.

Castroviejo, R. **Corneal transplantation.** Amer. Jour. Nursing, 1946, v. 46, Jan., p. 35.

Most favorable for keratoplasty are corneas with: central opacities in which the transplant will remain surrounded by healthy tissue; keratoconus when vision cannot be improved by regular or contact lenses or when the latter are not tolerated; and not too extensive intersititial keratitis. Less favorable are some corneal dystrophies, diffuse superficial opacities, adherent leucomas, and descemetoceles.

Various types of operation are described. It is the opinion of the author that this operation offers no greater risk than do operations for cataract, glaucoma, and detachment of the retina. The results compare favorably with those of operations routinely practiced by ophthalmic surgeons.

Francis M. Crage.

Dame, L. R. **Accessory lacrimal gland on the cornea.** Amer. Jour. Ophth., 1946, v. 29, May, pp. 579-582. (6 figures, references.)

Donahue, H. C. **Complications of herpes zoster ophthalmicus.** Amer. Jour. Ophth., 1946, v. 29, May, pp. 582-585. (See Section 14, Eyelids and lacrimal apparatus.)

Evans, C. A., and Bolin, V. S. **Corneal reactions to viruses of equine encephalomyelitis after intraocular injection,** Proc. Soc. Exper. Biol. and Med., 1946, v. 61, Feb., p. 106.

It has been shown that injections of certain viruses produce specific reactions in occular tissues. In these studies the viruses of western and eastern equine encephalomyelitis were injected into the anterior chambers of the eyes of rabbits. Corneal edema and opacification were produced, analogous to the toxic reaction demonstrated for the influenza virus. In general, the viruses could not be found in the aqueous after 48 hours, demonstrating that the corneal opacity is not the result of growth of the virus in the eye, even though such growth may take place to a limited

extent. As in the case of the influenza virus, large doses were required to produce the corneal reaction (the most characteristic ocular change noted). It is felt that the corneal changes are attributable to the toxic properties of the viruses used. Benjamin Milder.

Friede, R. **The origin of pterygium and keratoplasty for its recurrence.** Klin. M. f. Augenh., 1943, v. 109, Jan.-Feb., p. 41.

Many features in the clinical picture of pterygium are still uncertain. Whether the disease is a manifestation of a lesion of the cornea or the conjunctiva is still in dispute. Friede believes that it probably originates in the episclera, possibly under the influence of an unknown pathogenic germ. Hereditary factors, mechanical influences such as pressure of the lids, and various chemical and physical irritants may play a part in the development of pterygium. It is Friede's conviction that the operative procedures should be applied as early as possible and that simple excision is contraindicated since it may be followed by shrinkage, recurrence, and impeded ocular movements toward the temporal side. He advocates the recession of the entire structure with temporary suturing of the head to the caruncle, and closing of the conjunctival wound directly at the limbus. He believes that this is the simplest and most satisfactory operation. Transplantation of free or pedunculated flaps of conjunctiva as well as Thiersch grafts of skin and labial mucous membrane have been advocated repeatedly in order to avoid or cure recurrences. The aim of all these methods is the formation of a wall at the limbus to prevent new episcleral and conjunctival tissue from crossing the corneoscleral region. This is particularly indicated when the neck of the pterygium is wide. Corneal flaps taken either from the patient's own eyes or from enucleated or cadaver eyes gave most satisfactory results in cases of recurrences. These flaps, if properly secured, heal well and quickly, before the vascularized conjunctival and episcleral tissue has time to cross. The flaps stay clear for about two weeks; later they become opaque and are completely absorbed eventually. It is important to remove as much as possible of the episcleral tissues from the posterior surface of the pterygium while performing the recession. F. Nelson.

Reis, J. L. **A corneal graft operation for recurrent pterygium.** Brit. Jour. Ophth., 1945, v. 29, Dec., pp. 637-640.

The common methods of pterygium operations aim at the separation and displacement of the pterygium from the cornea. This leaves an open scar of the cornea which becomes covered with conjunctiva and forms a pseudopterygium which has a tendency to grow. To prevent this complication, a modified McReynolds pterygium operation is described in which the denuded corneal area is covered by a corneal graft under a conjunctival flap.

The procedure is described in detail as it was performed on an eye with recurrent pterygium. (1 drawing.)

Edna M. Reynolds.

Smelser, G. K. **The influence of vehicles and form of penicillin and sulfonamides on mitosis and healing of corneal burns.** Amer. Jour. Ophth., 1946, v. 29, May, pp. 541-551. (5 figures, references.)

Schaeffer, A. J. **Effect of certain amino acids on healing of experimental**

wounds of the cornea. Proc. Soc. Exper. Biol. and Med., 1946, v. 61, Feb., p. 165.

An attempt has been made to influence regeneration of experimental wounds of the cornea, in vivo, by the administration of amino acids. In the first of a series of experiments, corneas were abraded over a measured area in both eyes of each animal. A solution which included cystine, proline, asparagin, and glutamine in saline solution was instilled in the right eye. In another series an ointment was used. In the treated eyes, healing was complete in 12 to 42 hours, whereas in the control eyes, healing took place in 55 to 120 hours. In the third group, deep corneal lesions were similarly treated, and healed in 32 to 56 hours, as compared with four to five days in the control group.

The author has used amino-acid preparations in man in the treatment of 100 corneal lesions.

Benjamin Milder.

Wright, H. B. **Corneal transplantation and nursing care.** Amer. Jour. Nursing, 1946, v. 46, Jan., p. 36.

The author, a registered nurse, describes preoperative and postoperative care in detail. Particular emphasis is placed on the mental state of the patient. Acquainting the patient with his surroundings helps to prevent the lost feeling he might have on his return from the operating room. A special stretcher is used to transfer the patient to his bed. Details of a diet intended to prevent the use of the facial muscles in chewing are given. The author advises against the use of tooth brushes, suggesting instead the use of liquid mouth washes through a tube and applicators to cleanse the teeth.

Francis M. Crage.

7

UVEAL TRACT, SYMPATHETIC DISEASE, AND AQUEOUS HUMOR

Bietti, G. B. **Bilateral fissurelike pupils associated with Bitot's spots.** Studi Sassares, 1943, v. 21, pp. 1-11.

An infant girl, aged 1½ years, presented congenital, bilateral fissured pupils, placed obliquely. There was slight light reaction and the child followed a light readily. No other congenital defects were observed, but there were xerotic triangular areas on the temporal side of the bulbar conjunctiva that resembled Bitot's spots, although there was no evidence of avitaminosis.

The condition may be unilateral or bilateral and the fissures may be parallel, oblique, vertical, or horizontal. Other congenital defects are often found in association with the pupillary defect, and heredity is occasionally a factor. A good discussion and bibliography complete the article. (1 figure.)

Eugene M. Blake.

Blum, J. D. **Indications and results from Franceschetti's corepraxy.** Ophthalmologica, 1943, v. 106, July, pp. 1-12, and Ophthalmologica, 1943, v. 106, Aug., pp. 66-79.

The author considers Franceschetti's corepraxy a new and very effective method of producing an artificial pupil, especially in surgical cases of aphakia with displaced and partially occluded pupil, after postoperative complications.

He reviews the history of the surgery of the artificial pupil; mentions iridocapsulotomy and iridocapsulectomies as well as other more complicated procedures like Blaskovics's cicatricetomy; describes the surgical technique of these operations and discusses their

improvement, dangers, disadvantages.

Corepraxy is considered to be a less harmful operation in properly selected cases. It is most favorable in aphakic eyes in which the pupil is greatly displaced upward and is occluded by a membrane that is not adherent to the iris. Eyes with iris prolapse, thick, calcified, pupillary membrane, vitreous changes, or considerable corneal disease are less promising.

The surgery is performed as follows: Through a small keratome incision opposite the last remains of the pupil, a pointed hook is introduced. The hook is manipulated so as to catch the pupillary margin and bring the iris out through the incision, where it is cut by a deWecker scissors. An atrophic iris might not give way but tear instead. In this case several similar tears are made to form some kind of pupil. The resulting pupil is usually oval, in contradistinction to the slit-shaped pupil that is the result of other surgical methods. In traumatic pupillary displacements in young persons, an operation sometimes results in a thin slit, instead of the desired oval artificial pupil. It is a mistake to try to enlarge the pupil at once; more advisable to wait and to perform another corepraxy later, perpendicular to the first.

A description of 20 cases of corepraxy follows. Sixteen eyes were aphakic, two had glaucoma, and two had displaced pupils after injuries. In spite of the generally poor prognosis in this type of operation the author did not lose any eye, even when he operated on eyes which were hypotonic before the surgery. An improvement of vision resulted in 17 out of the 20 eyes; in the other three retinal detachment, hemorrhagic glaucoma, and hypotony developed. (References.)

Alice R. Deutsch.

Donahue, H. C. **Complications of herpes zoster ophthalmicus.** Amer. Jour. Ophth., 1946, v. 29, May, pp. 582-585. (See Section 14, Eyelids and lacrimal apparatus.)

Harley, R. D., and Wedding, E. S. **Syndrome of uveitis, meningo-encephalitis, alopecia, poliosis, and dysacousia.** Amer. Jour. Ophth., 1946, v. 29, May, pp. 524-535. (17 figures, references.)

Icaza y Dublan, J. M. **Cholestorin in the anterior chamber.** Bol. del Hosp. Oft. de Nuestra Señora de la Luz, 1946, v. 3, Jan.-April, pp. 143-146.

The patient was a married woman of 20 years. Three years previously, some of her family had noticed that the right eye looked like a cat's eye, having a yellowish reflex. The eye was without pain. Upon examination the right iris was found to have undergone degeneration, and there was complete posterior synechia with a pupillary membrane. The intraocular pressure was above normal and there was no light perception.

The striking feature of the case was that the lower half of the anterior chamber was occupied by innumerable iridescent particles. Some of the floating crystals were needlelike, others formed plaques, some did not glisten. It is suggested that the initial stage of the formation of the cholesterin crystals had been a metastatic abscess in the vitreous, and that the general ocular disturbance had been induced by uterine infection. Several years previously, the patient had had two abortions within four months. She had since given birth to a healthy child.

W. H. Crisp.

Johnson, K. B. **Metastatic carcinoma of the choroid.** Canadian Med. Assoc. Jour., 1946, v. 54, Jan., p. 46.

The author describes four cases of metastatic carcinoma of the choroid. In each patient the carcinoma was primary in the breast, which is the commonest site of the primary growth. In three patients metastases in other organs had not been found before those that had invaded the eye. In two, the ocular lesion had occurred seven years after the primary growth. In three, chest metastasis was eventually found. Ophthalmoscopically, a detachment of the retina extended up to the disc in all cases.

The patients live from four weeks to two years after discovery of the metastatic tumor and usually die in the fourth and fifth decade of life. The metastasis in the eye results from blood-borne emboli of tumor cells.

A flat thickening of the choroid is present, higher at the posterior pole. The vitreous remains clear, and a large detachment of the retina may occur at any time. Growth is rapid but glaucoma is late. Early pain is diagnostic.

Francis M. Crage.

Laval, Joseph. **Bilateral uveitis with retinal detachment, poliosis, alopecia, and dysacousia.** Amer. Jour. Ophth., 1946, v. 29, May, pp. 536-540. (2 figures.)

8

GLAUCOMA AND OCULAR TENSION

Gradle, H. S. **Preglaucoma.** Amer. Jour. Ophth., 1946, v. 29, May, pp. 520-523.

Paulo Filho, A., Sébas, S. R., and Giardulli, A. **Siderosis bulbi.** O Hospital, 1945, Sept., pp. 339-343 (reprint.)

Microscopic section of an enucleated eyeball in which this complication had arisen leads to the following conclusions: The presence of an iron fragment in the anatomic elements of the anterior pole of the eyeball does not always produce siderosis bulbi. The siderosis once begun continues even after the foreign body is removed. Rarely the siderosis involves all the anatomic elements of the eyeball. It causes necrosis of the essential cells of the retina. (3 figures, references.) W. H. Crisp.

Paulo Filho, A., and Sebas, S. R. **Artificial thickening of the conjunctival flap in fistulizing operations.** Brasil-Medico, 1945, v. 59, April 7 and 14, 9 pp. (reprint.)

The authors' technique is recommended as especially protecting against the risk of iridocyclitis. They begin the conjunctival incision near the superior fornix, cutting down to the sclera. Care is taken to carry down with the flap as much as possible of the connective tissue. Then the bulk of the subconjunctival connective tissue is separated from the conjunctiva itself, by means of scissors, and over as large an area as possible, so that this layer of tissue is accumulated at the base of the flap. After completing the other steps of the operation (whatever form of fistulizing operation is employed), and following suture of the lips of the conjunctiva, a spatula inserted at the temporal extremity of the sutured incision is used to depress the soft connective tissue down to the region of the anticipated filtration bleb. (3 figures.)

W. H. Crisp.

Roetth, A. de. **Cyclodiathermy in treatment of glaucoma due to rubeosis iridis diabetica.** Arch. of Ophth., 1946, v. 35, Jan., pp. 20-22.

Rubeosis of the iris in diabetes is one of the most disastrous ocular diseases, for it usually involves both eyes and,

with rare exceptions, causes uncontrollable glaucoma. In none of the 32 cases of this disease found in the literature could miotics control the tension. The usual surgical procedures were useless, or even disastrous. The intolerable pain caused by the glaucoma necessitated enucleation in several cases. Fralick, in his excellent and comprehensive paper on this subject, reported the removal of four eyes in three cases of diabetic rubeosis of the iris. Any attempt to save some of the vision, or even the eyeball alone, is worth while.

After disappointing results with various types of operations, the author found that cyclodiathermy is the only procedure that reduces the tension in cases of glaucoma due to rubeosis. However, the treatment easily results in atrophy of the eyeball if used too extensively, particularly if both long posterior ciliary arteries are destroyed. These vessels are not damaged if the applications are made in front of the insertion of the rectus muscles as suggested by Vogt. But even if the cyclodiathermy is not done over a sufficiently large area to normalize the tension, it does alleviate the pain. Unfortunately, the progress of the damage to the retinal vessels cannot be checked.

R. W. Danielson.

Torres Estrada, Antonio. **Medical and surgical control of glaucoma.** Bol. del Hosp. Oft. de Nuestra Señora de la Luz, 1945, v. 3, Sept.- Dec., pp. 89-109.

This is a somewhat detailed consideration of the treatment of glaucoma. The author regards chronic simple glaucoma as a malady arising from a general systemic cause. He recognizes two distinct periods in development of the disease, functional and degenerative. The functional period is susceptible of being treated with success in the medical field. The degenerative period calls for surgery, which should be undertaken as soon as medical care is unable to maintain adequate reduction of tension. Hemicyclodialysis is the author's surgical treatment of choice, tending to reëstablish physiologic drainage of the aqueous humor. In advanced cases this operation should be combined with iridectomy. (9 figures.)

W. H. Crisp.

Torres Estrada, Antonio. **Hemicyclodialysis is an operation which reëstablishes physiologic drainage of the intraocular fluids.** Bol. del Hosp. Oft. de Nuestra Señora de la Luz, 1946, v. 3, Jan.-April, pp. 121-129.

This paper, presented to the Second Pan-American Congress of Ophthalmology, Montevideo, discusses the general principles of glaucoma surgery, and urges the advantage of doing a very extensive cyclodialysis, to which the author has given the title "hemicyclodialysis," and which he considers superior to any of the filtration operations. He believes that the action of hemicyclodialysis is by opening the canal of Schlemm and the meshes of the pectinate ligament. The operation is particularly effective in the early stages of chronic simple glaucoma. The failure of any glaucoma operation is probably attributable to advanced sclerotic and degenerative changes in the pectinate ligament. (2 illustrations.)

W. H. Crisp.

9

CRYSTALLINE LENS

Geller, K. **Late traumatic rosette after contusion with Vossius's ring opacity.** Klin. M. f. Augenh., 1943, v. 109, Jan.-Feb., p. 105.

A Vossius ring combined with rosette-shaped opacities at the anterior and posterior surface of the senile nucleus was seen in the eye of a locksmith. He had had a contusion about 30 years before and his vision had become considerably impaired shortly after the injury. F. Nelson.

Goar, E. L., and Potts, C. R. **The relationship of rubella in the mother to congenital cataracts in the child.** Amer. Jour. Ophth., 1946, v. 29, May, pp. 566-569. (References.) Also in Trans. Amer. Ophth. Soc., 1945.

Prendergast, J. J. **Congenital cataract and other anomalies following rubella in mother during pregnancy.** Arch. of Ophth., 1946, v. 35, pp. 39-41.

The reported cases of congenital defects in children born of mothers who had rubella during the first three months of pregnancy are briefly reviewed. The pathologic observations in the cases of congenital cataract and the possible significance of the time of development of these anomalies in the embryo are discussed. The results of a survey made among some of the ophthalmologists, pediatricians, and obstetricians in California to estimate the incidence of these defects in the state are reported. R. W. Danielson.

Rosen, Emanuel. **Diabetic needles.** Brit. Jour. Ophth., 1945, v. 29, Dec., pp. 645-653.

The author reports a characteristic lenticular opacity associated with diabetic cataract which he considers a presumptive if not a positive diagnostic sign in diabetes. The sign is not constant but when present is specific for diabetes. The sign consists of lenticular opacities in the periphery of the lens which are linear streaks no thicker peripherally than centrally.

A series of 19 cases of diabetes is presented, all of which showed the diabetic-needle sign. Drawings of the opacities of the lens in each case are included. Many showed nuclear and cortical lens opacities as well as the diabetic needles. Edna M. Reynolds.

Rosen, Emanuel. **Coppock cataract and cataracta pulverulenta centralis.** Brit. Jour. Ophth., 1945, v. 29, Dec., pp. 641-644.

A report of four cases of central pulverulent cataract is given with a series of slitlamp photographs. The lesion is believed to have a strong familial tendency but the author reports having seen 24 in 18 months. There were several colored patients in this group.

The opacity occupies the most central portion of the lens and its center is somewhat transparent. It is composed of small, white dots which are highly refractile, located in the fetal nucleus.

In three of the patients, some endocrine dysfunction was noted. One patient, a man, 26 years of age, had soft, silky hair in the female pattern of distribution, adiposogenital dystrophy, and a high-pitched voice. A second patient had congenitally small kidneys and the third had an acrocyanosis.

The author recommends that the term "Coppock cataract" be dropped for this type of opacity and that an anatomically selected term be substituted. (4 figures, references.)

Edna M. Reynolds.

Szinegh, B. **Anterior capsular cataract complicated by bilateral zonular cataract in a twin.** Klin. M. f. Augenh., 1943, v. 109, Jan.-Feb., p. 83.

Of two identical twin brothers, seven years of age, one was normal although

slightly rachitic and retarded in development; the other had anterior polar and zonular cataracts in both eyes. He also had rickets and had suffered from frequent convulsions, possibly a manifestation of tetany, although the blood calcium was of normal value and the existence of a latent tetany could not be proved. It is most likely that the cataracts were caused by a pathologic process in early fetal life, although it is not known what kind of lesion was responsible. Cataracts that are a manifestation of a defect of the germ plasma appear in both twins. (References.)

F. Nelson.

Thannhauser, S. J. **Werner's syndrome (progeria of the adult) and Rothmund's syndrome; two types of closely related heredofamilial atrophic dermatoses with juvenile cataracts and endocrine features.** Ann. Int. Med., 1945, v. 23, Oct., p. 559.

The symptoms of Werner's syndrome are demonstrated in case reports in the literature and in four of the author's own. With the exception of Oppenheimer and Kugel's cases, the cases of Werner's syndrome in the literature are published under the misleading designation "Scleroderma and cataracts."

The skin changes in Werner's syndrome are not those of true scleroderma. Because of its heredofamilial occurrence it is suggested that the skin changes, as the other symptoms of Werner's syndrome, are the result of a defective germplasm which does not appear until the second and third decades of life. "Progeria of the adult" is suggested as a better name since all symptoms of Werner's syndrome result in presenility of the patient.

For the skin changes a purely descriptive name, such as "heredofamilial atrophic dermatosis with skin ulcers" seems more appropriate.

The skin ulcers in Werner's syndrome are not entirely trophic in origin. They appear only on exposed parts and are probably the result of pressure upon the thin, atrophic, and stretched skin. The healing of the ulcers by grafting skin upon the defects supports such an opinion.

The symptoms of Rothmund's syndrome are illustrated by case reports in the literature and by a case of the author's own.

The skin changes of Rothmund's syndrome are classified as "poikiloderma" or "scleropoikiloderma." Such a classification is not justified by the heredofamilial occurrence of the skin disorder nor by the histologic findings. It seems appropriate to use a simple descriptive name such as "heredofamilial atrophic dermatosis with telangiectases."

Both syndromes may occur in incomplete forms.

The heredity in both forms is recessive. The collateral occurrence in brothers and sisters of one generation is often observed. Rothmund's syndrome usually starts in childhood; Werner's syndrome in the second and third decade.

Clinical syndromes related to Werner's and Rothmund's syndromes are discussed. A chart tabulating the characteristics of Werner's and Rothmund's syndromes in comparison with related clinical entities is presented to aid in the differential diagnosis.

Cataracts are of the same kind in both syndromes. They develop as starlike opacities in the periphery of the lens, mostly at the posterior pole. However, the age at which the cataracts begin to develop is significant. In Rothmund's syndrome they are present at

the age of three to five years; in Werner's syndrome they develop in adult life, between the ages of 20 and 30 years.

That these syndromes are the result of a purely ectodermal dysplasia or a primary disturbance of endocrine function is denied. Their recessive heredity suggest that multiple defects of the germ-plasm become manifest in abiotrophic degeneration of various organs at different periods of life.

Theodore M. Shapira.

10

RETINA AND VITREOUS

Buxton, R. J. **Retinal haemorrhages in aplastic anaemia**. Brit. Jour. Ophth., 1945, v. 29, Dec., pp. 632-635.

The retinal lesions found in a severe and fatal case of aplastic anemia are described and illustrated.

The patient, a male, was 28 years of age. He was admitted to a hospital after two days of illness with generalized aching, fever, and bleeding gums. He had had syphilis, and had completed two full courses of treatment with arsenic and bismuth. He had received the first injection of the third course three days before hospital admission.

The patient's blood picture showed hemoglobin 16 percent, red blood cells 750,000, white blood cells, 3,100, polymorphonuclear leucocytes 19 percent, lymphocytes 78 percent, mononuclear cells 3 percent, and very few platelets. Bleeding time was greatly prolonged. Clotting time was normal. A blood-film study showed no evidence of blood regeneration.

The ophthalmic examination showed marked pallor of the conjunctiva and in the fundus of each eye there was blurring of the upper nasal edge of the optic disc. The retinal vessels were normal in size and contour. There were gross hemorrhages of three types; namely, moderate-sized, flame-shaped plaques up to 2 D.D. long, some with a yellowish center, and glistening slightly; narrow streaks, about 1 D.D. long, close to blood vessels; and two or three punctate hemorrhages in the macular areas. One small spot of exudate was noted. There was general retinal pallor and a slight degree of retinal edema surrounding the optic disc.

The patient was given a number of blood transfusions, 300 gm. of ascorbic acid daily, 2 c.c. of neohepatex intramuscularly daily, and iron and ammonium citrate.

The patient died. The post-mortem examination showed the classical picture of complete bone marrow aplasia and multiple submucous hemorrhages. (1 figure.) Edna M. Reynolds.

Easton, D. M. **Acetylcholine in the light and dark adapted frog retina.** Proc. Soc. Exper. Biol. and Med., 1945, v. 59, p. 31. (See Section 3, Physiologic optics, refraction, and color vision.)

Fink, A. I. **Clinical study of effect of tobacco on the normal angioscotoma.** Arch. of Ophth., 1946, v. 35, Jan., pp. 15-19.

In 1926, the classic form of the angioscotoma was first described by Evans. This work has been a source of aid to clinicians investigating disease of the nasal accessory sinuses, forms of edema, glaucoma, and menstrual disturbances. The research worker, too, has had recourse to angioscotometry in studying the effects of sulfanilamide, inhalation of oxygen, and amphetamine

sulfate, and in making studies of the effects of high altitude on the visual fields during World War II. The method has not been used, however, to determine the effect of smoking on the normal angioscotoma. Since tobacco smoking is so widespread, it was thought that knowledge of its effect might be of clinical and experimental value. It was therefore decided to study the effect of smoking one cigaret with inhalation.

The smoking of a certain popular brand of cigaret containing two percent nicotine produced a widening of the angioscotoma, cigarets containing one tenth as much nicotine produced an alteration of the angioscotoma of lesser degree, and the controlled inhalation of an unlighted cigaret produced no alteration of the angioscotoma.

It seems probable that the effect on the angioscotoma was brought about by the nicotine. R. W. Danielson.

Hoffman, P. M. **Retinal venous thrombosis following reaction to vaccine**. Arch. of Ophth., 1946, v. 35, Jan., pp. 45-46.

The uncommon occurrence of retinal periphlebitis and progressive thrombosis in a young adult following stimulating doses of vaccines with associated anaphylactoid reaction is recorded.

In the early stage the inferior temporal veins were involved, and progressive thrombotic changes in the fundus and visual fields were followed. It is of interest that the superior nasal veins, although they had presented similar early periphlebitic constrictions and exudate, did not become thrombosed, and the exudate disappeared completely. Optic neuritis occurred in the affected eye during the third week of the disease, followed one week later by a macular lesion. Ocular tension was not notably affected during six weeks' observation of the patient.

R. W. Danielson.

Márquez, Manuel. **Technique and clinical value of hypertonic injections into Tenon's capsule for detachment of the retina**. Monterrey Medico, 1945, March 31, pp. 2397-2403.

Márquez says the technique here given does not appear in any book. He describes a case of retinal detachment of traumatic origin. There was a small tear at the level of the macula, through which could be seen the red color of the choroid. The tear was so small that it could not be seen in the indirect image. The detached area involved more than one half the retina, and invaded the macula. Central vision was absent.

After a preliminary anesthetic injection of 2-percent novocaine, a 15-percent solution of sodium chloride, with a small amount of novocaine was injected with a curved needle, beveled toward its concavity and the concavity directed toward the eyeball. The injection was made downward and somewhat outward, as far backward as possible in Tenon's space. Two days later the retina was found reattached, with the visual field almost entirely restored including that of the macular region, but with a slight defect below. The macular tear was closed, although the injection had not been made at its level. A similar injection was made six days later, the field continuing to gain. All that now remained of the tear was a small dark scar. The final visual acuity of this eye was 0.7: the original visual acuity was unknown. In a second case the result was unsatisfactory. (1 field.)

W. H. Crisp.

Rados, A. **Occurrence of glioma of retina and brain in collateral lines in**

same family. Arch. of Ophth., 1946, v. 35, Jan., pp. 1-12.

In this monographic study the hereditary basis of malignant growths, especially that of retinoblastoma, is evaluated with reference to horizontal, vertical, and collateral inheritance in the family history. The importance of research on twins is stressed.

A case of glioma of the retina and one of glioma of the brain, occurring in collateral lines, and hitherto undescribed, are reported. R. W. Danielson.

Rosen, E. **Congenital retinal fold.** Arch. of Ophth., 1946, v. 35, Jan., pp. 28-32.

The author reviews the literature and reports two cases. The mother of one patient had measles during the fifth month of pregnancy. Congenital retinal folds have been confused with glioma.

R. W. Danielson.

Welt, Milton. **A clinical study of the relation of the size of Mariotte's blind spot and the angioscotomas to retinal arterial hypertension.** Ophthalmologica, 1945, v. 109, Feb.-March, pp. 137-158. (See Section 1, General methods and diagnosis.)

11

OPTIC NERVE AND TOXIC AMBLYOPIAS

Bruetsch, W. L. **Malaria therapy in syphilitic optic atrophy.** Jour. Amer. Med. Assoc., 1946, v. 130, Jan. 5, p. 14.

The author advocates the abandonment of intraspinal therapy in neurosyphilis because a sudden loss of vision occurs in the course of this treatment in 10 percent of the patients.

The term "tabetic optic atrophy" should be discarded and replaced by "primary syphilitic optic atrophy," because this atrophy not infrequently occurs in dementia paralytica, in meningo-vascular syphilis, and even in syphilitic persons without tabes.

The local pathologic changes are identical in the three main types of neurosyphilis. The atrophy is a chronic inflammatory process followed by nerve-fiber degeneration that starts in the intracranial portion of the nerve and spreads in both directions.

Activation of the mesodermal tissue and not the hyperpyrexia seems responsible for the arrest of the disease. Fever alone is not deleterious to the Treponema pallidum.

When one course of malaria does not prevent further visual loss, another course is indicated. The second course requires the use of quartan malaria since immunity to the tertian type will have taken place in the interval. Since penicillin reduces the anti-inflammatory action of malaria therapy in neurosyphilis it might be advisible to administer penicillin with the malaria treatment, or after it; to use penicillin alone would be hazardous.

In the author's post-mortem studies, the arachnoidal adhesions about the optic nerves and chiasm were not the cause of the optic-nerve degeneration in the majority of cases.

Patients in whom examination of the spinal fluid is positive for syphilis should have a yearly study of the visual field. Even though the discs may appear normal, early narrowing of the field would justify a diagnosis of beginning syphilitic primary optic atrophy. Corrective therapy for vitamin deficiency is considered of no importance in this disease. Francis M. Crage.

Dansey-Browning, G. C., and Rich, W. M. **Ocular signs in the prisoner of war returned from the Far East.** Brit.

Med. Jour., 1946, v. 1, Jan. 5, p. 20. (See Section 17, Systemic diseases and parasites.)

Knapp, A. A. **The eye as a guide to latent nutritional deficiency diseases; a clinical study of ocular diseases at an advanced base hospital in the Southwest Pacific.** Bull. New York Acad. Med., 1946, v. 22, April, p. 217. (See Section 17, Systemic diseases and parasites.)

Ridley, Harold. **Ocular manifestations of malnutrition in released prisoners of war from Thailand.** Brit. Jour. Ophth., 1945, v. 29, Dec., pp. 613-618. (See Section 17, Systemic diseases and parasites.)

Sautter, Hans. **Spotted typhus and eye.** Klin. M. f. Augenh., 1943, v. 109, Jan.-Feb., p. 24. (See Section 17, Systemic diseases and parasites.)

12

VISUAL TRACTS AND CENTERS

Chambers, D. L. **Gunshot wound of both orbits.** Lancet, 1946, Jan. 19, p. 93. (See Section 16, Injuries.)

Hughes, E. B. C. **Indirect injury of the optic chiasma—a case report.** Brit. Jour. Ophth., 1945, v. 29, Dec., pp. 629-632.

A case of indirect injury to the optic chiasma in which operative and pathologic inspection was made, is reported. The patient, a man aged 45 years, sustained a severe craniocerebral injury as the result of an accident in which he struck his head against the windshield of a truck. There was no scalp wound but severe bruising of both orbits and frontal regions. X-ray films showed a horizontal fracture above the frontal sinuses, with extensions vertically downwards into the right frontal sinus and into the roof of the left orbit. A posttraumatic amnesia of 24 hours' duration and a lumbar puncture, soon after injury, that showed a small amount of blood and some 60 cells per cu. mm. in the cerebrospinal fluid, indicated the severity of his cerebral injury. The neurologic signs at the time of hospital admission consisted of bilateral anosmia, loss of taste, complete facial paralysis on the right side, and a mild hemiparesis on the left side with increase of tone and of the deep reflexes. The optic discs were abnormally pale in each eye; visual acuity O.U. was 6/9, and there was complete loss of the temporal visual field in each eye.

At the time of operation for repair of the dural defect near the right frontal sinus, an excellent view of the chiasma and of both optic nerves was obtained. No gross lesion was found. No change in the appearance of the fundi or fields had occurred four months after the injury.

The author believes that the small vessels of the chiasma were damaged by stretching and that the injury to the nerves was probably secondary to this disturbance. (3 illustrations, references.) Edna M. Reynolds.

Macaskill, J. **A case of occipital lobe injury.** Brit. Jour. Ophth., 1945, v. 29, Dec., pp. 626-628. (See Section 16, Injuries.)

13

EYEBALL AND ORBIT

Paul, Milroy. **Cavernous hemangioma of the orbit successfully removed by Shugrue's operation.** Brit. Jour. Ophth., 1946, v. 30, Jan., p. 35.

On a patient presenting a marked

monocular protrusion of six months' duration, a large tempero-frontal scalp flap was made. The outer rim and lateral wall of the orbit were removed and a tumor, the size of a marble, was seen within the muscle cone. It was easily shelled out and removed. The wound was closed with a minimum of deformity, and the only sequela was a limitation of lateral movement of the eye. The tumor was found to be a cavernous hemangioma. There had been surprisingly little bleeding after its removal. This method is the Shugrue operation described in Spaeth's "Ophthalmic surgery." Morris Kaplan.

Rycroft, B. W. **Sub-conjunctival penicillin and intraocular infection.** Brit. Jour. Ophth., 1945, v. 29, Oct., pp. 501-511. (See Section 2, Therapeutics and operations.)

14

EYELIDS AND LACRIMAL APPARATUS

Callahan, Alston. **The removal of adjacent nevi of the eyelids.** Amer. Jour. Ophth., 1946, v. 29, May, pp. 563-565. (7 figures.)

Chi, H. H. **Herpes zoster ophthalmicus.** West China Med. Bull., 1945, v. 2, June 15, p. 61.

After reviewing the literature in brief, the author describes the characteristic symptoms and signs in five patients. Aside from symptomatic treatment, diphtheria antitoxin was administered. The anti-toxin injections alleviated pain and improved the skin condition in 24 to 72 hours. The course of the disease was shortened, and was not followed by neuralgia. (References.) China Medical Journal.

Donahue, H. C. **Complications of herpes zoster ophthalmicus.** Amer. Jour. Ophth., 1946, v. 29, May, pp. 582-585.

Fox, S. A. **Some methods of lid repair and reconstruction.** Amer. Jour. Ophth., 1946, v. 29, April, pp. 452-458. (6 figures, references.)

Friedman, B., and Gernand, H. **Sjøgren's syndrome treated with stilbesterol.** California and Western Medicine, 1946, v. 64, Jan., p. 31. (See Section 5, Conjunctiva.)

MacLean, A. L. **Sjøgren's syndrome.** Johns Hopkins Hospital Bull., 1945, v. 76, May, p. 179.

Deficient lacrimation may produce a troublesome keratoconjunctivitis. The patients complain of burning, pricking, and smarting of the eyes, and occasionally of diminished visual acuity. There is a stringy discharge. The cornea often can be stained, and fine epithelial filaments may be present. There is swelling of the parotid gland and dryness of the mouth, nose, and eyes. Schirmer's test shows deficient tear production. The differential diagnosis and the theories of etiology are discussed.

The treatment consists of the use of parasympathetic stimulating agents to increase glandular secretion; the instillation of collyriums and, best of all, the occlusion of the canaliculi. Three cases of Sjøgren's syndrome are described. Robert N. Shaffer.

Mattsson, Ragnor. **A grain of rye as a foreign body in the upper lacrimal canaliculus.** Acta Ophth., 1942, v. 20, pts. 3-4, pp. 307-309.

A farmer 27 years of age, had a purulent discharge from the right lacrimal sac, which was not relieved by a dacryocystectomy. When he was examined

a grain of rye, surrounded by granulation tissue, was found imbedded in the upper lacrimal canaliculus. After its removal, the patient had no further difficulties. It is assumed that it entered through the nose, and was forced upwards through the lacrimal sac by violent blowing of the nose. (Illustration.) Ray K. Daily.

15
TUMORS

Claus, S. **Nevogenous pterygium.** Klin. M. f. Augenh., 1943, v. 109, Jan.-Feb., p. 59. (See Section 6, Cornea and sclera.)

Goodman, E. G., and Iverson, L. **Chloroma, a clinico-pathologic study of two cases.** Amer. Jour. Med. Sci., 1946, v. 211, Feb., p. 205.

Two patients with chloroma, both presenting symptoms and signs of a rapidly growing tumor producing extreme exophthalmos, are described. The hematologic picture was identical with that of an acute myelogenous (myeloblastic) leukemia. Chloroma may be present as small, well-circumscribed nodules, or as large, solid masses with particular predilection for meninges, periosteum, mucous membranes, endothelium, or mesothelium. The exact chemical nature of the green pigment has not been demonstrated either by spectroscopic or by polariscopic studies. It may be an intermediary product in the breakdown of hemoglobin to bilirubin. R. Grunfeld.

Mao, W. S. **Adrenal neuroblastoma.** West China Med. Bull., 1945, v. 2, June 15, p. 40.

Only two cases of adrenal neuroblastoma have been reported in the Chinese literature. The case herein reported was in a child, aged three years, first seen in the Pediatric Service of the United Hospital of the Associated Universities in Chengtu. The chief complaints were abdominal pain and swelling of the left eyelids. Subsequent examinations showed bilateral ecchymosis of the lids with exophthalmos, subconjunctival hemorrhage, and retinal hemorrhage in the left eye. General physical examination revealed lymph adenopathy, hepatomegaly, splenomegaly, and anemia. Finally the child died at home. (References.)

China Medical Journal.

Paul, Milroy. **Cavernous hemangioma of the orbit successfully removed by Shugrue's operation.** Brit. Jour. Ophth., 1946, v. 30, Jan., p. 35. (See Section 13, Eyeball and orbit.)

Paulo Filho, A., and Sebas, S. R. **Two cases of preëpitheliomatous dyskeratosis of the cornea and conjunctiva (Bowen's disease).** Rev. Brasileira de Cirurgia, 1945, April (reprint).

More or less closely related to molluscum contagiosum and Paget's disease, this condition has often been called atypical chronic epithelial proliferation, and is included in the precancerous dermatoses. Clinically it appears in the form of nodules on the bulbar conjunctiva, vascular and slightly elevated, united to one another by areas of lesser density. Microscopically the epidermis presents a disorderly arrangement of cells of unequal size, with nuclei which may be large or small, clumped, fragmented, or multiple. The condition may invade the cornea, to which, however, it is loosely attached. The treatment is excision, but it may easily occur that some cells are left in place and lead to recurrence. (6 photomicrographs, references.)

W. H. Crisp.

White, J. P. **Haemorrhage from the conjunctiva.** Notes on a case of capillary angioma. Brit. Jour. Ophth., 1945, v. 29, Dec., pp. 635-637. (See Section 5, Conjunctiva.)

16

INJURIES

Chambers, D. L. **Gunshot wound of both orbits.** Lancet, 1946, Jan. 19, p. 93.

An American soldier with a healed septic wound located in the outer half of the left infraorbital margin was admitted to the British Prisoners-of-War Hospital in February, 1945, after having been treated at various German hospitals. The vision in each eye was 6/24. Both eyeballs were intact but were not in normal position. There was some limitation of ocular movement and diplopia in all fields. X-ray examination revealed a foreign body the dimensions of which were 35 by 20 by 3 mm. and which was lodged transversely in the nose and encroached on both orbits. Removal by way of the left orbit was followed by healing by first intention, though the left antrum was filled with mucoid pus. The diplopia and limitation of movement remained but vision improved to 6/12.

Francis M. Crage.

Dansey-Browning, G. C. **Ophthalmic treatment in the field, 1943.** Brit. Jour. Ophth., 1946, v. 30, Jan., p. 26.

The author reports his observations on 148 wounded eyes of 129 men who were injured in the Italian campaign. Thirty-nine eyes were lost; of these 22 were hopeless at first examination. About 30 percent of the foreign bodies from German missiles were found to be magnetic. The injuries and their treatment are described individually. The liberal use of penicillin and sulfonamides both locally and generally is a tremendous advance in treatment. A plea is made for the "coal scuttle" type of helmet as a defense against ocular injuries.

Morris Kaplan.

Essen-Möller, Lars. **Transitory blindness after nonperforating injury to the skull.** Acta Ophth., 1940, v. 20, pts. 3-4, pp. 272.

Two cases are reported. A six-year-old boy was blind for three days following a blow on the head and a short loss of consciousness. The pupillary reactions were normal. After a steady improvement in vision and in his general condition for a week, the child suddenly became unconscious, developed left-sided epileptiform spasms, with conjugate deviation to the opposite side. An exploratory craniotomy was performed because intracranial hemorrhage was suspected but none was found. The day after the operation the child was lucid and his vision was good. He was found normal on reëxamination 3½ months later.

A girl, 15 years old, fell on the gymnasium floor. Six weeks after the injury she developed general neurologic symptoms, indicative of an intracranial lesion. The visual disturbances consisted of loss of visual acuity, horizontal and lateral nystagmus, outward deviation of the left eye, and slight ptosis on the left side. The fundus was normal in each eye. An exploratory craniotomy was performed through the left mastoid, because of a fracture line on the X-ray film behind the mastoid process. No abnormality was found, but the operation was followed by a rapid recovery from all symptoms.

These clinical pictures are attributed to vasomotor cerebral disturbances, caused by cerebral contusion.

Ray K. Daily.

Geller, K. **Late traumatic rosette after contusion with a Vossius ring opacity.** Klin. M. f. Augenh., 1943, v. 109, Jan.-Feb., p. 105. (See Section 9, Crystalline lens.)

Hughes, E. B. C. **Indirect injury of the optic chiasma—a case report.** Brit. Jour. Ophth., 1945, v. 29, Dec., pp. 629-632. (See Section 12, Visual tracts and centers.)

Kraus, J., and Briggs, W. A. **Intraocular foreign bodies. Problems of localisation and operative procedure.** Brit. Jour. Ophth., 1945, v. 29, Nov., pp. 557-579.

A new system of localization of radioopaque intraocular foreign bodies is described in detail as well as an improved operative technique in stages. This method gives the position of the foreign body in the particular globe to be operated upon and also the exact position on the sclera where the incision must be made to be in closest proximity to the foreign body.

The principles of magnetism as related to the success of extracting a foreign body from the eye are discussed, and a method of regulating the diathermy apparatus to avoid complications is outlined.

A diagram of a new forceps for the extraction of nonmagnetic foreign bodies is given. (27 illustrations.)

Edna M. Reynolds.

Murphy, P. J., and Schlossberg, L. **Eye replacement by acrylic manillofacial prosthesis.** The Military Surgeon, 1945, v. 96, June, p. 469. (See Section 2, Therapeutics and operations.)

Macaskill, J. **A case of occipital lobe injury.** Brit. Jour. Ophth., 1945, v. 29, Dec., pp. 626-628.

A case of injury to the right side of the back of the head in a soldier, 22 years of age, is reported. For one week after injury he could not see at all on the left side. Then objects far out on the left side became visible, but he was still aware of the blind area near the center of his vision on this side.

When examined three months after injury there was a healed depressed wound in the occipital region to the right of the midline. Both eyes were normal and had full vision. The peripheral areas of the visual fields were unimpaired, but there was a left-sided homonymous, hemianopic scotoma, with sparing of the fixation area. No other neurologic findings were present. X-ray studies showed several depressed bone fragments underlying the skull defect. Although the brain was penetrated to a considerable depth, consciousness was not disturbed. The initial loss of the whole field on the left side probably resulted from a functional disturbance of all the right visual area of the brain at the time of injury, and recovery commenced in that part of the field furthest from the injury. (Fields, references.)

Edna M. Reynolds.

Rycroft, B. W. **Ophthalmology in the B.N.A. and C.M. forces.** Brit. Jour. Ophth., 1945, v. 29, Nov., pp. 594-607. (See Section 18, Hygiene, sociology, education, and history.)

Scheie, H. G., and Hodes, P. J. **Injection of oxygen into Tenon's capsule.** Arch. of Ophth., 1946, v. 35, Jan., pp. 13-14.

Early in their experience, air, usually 6 c.c., was injected into Tenon's capsule, after which stereoscopic roentgenograms were made. Although the procedure was diagnostic and enabled one

to localize intraocular foreign bodies, it made hazardous any surgical intervention soon after the injection. The air in Tenon's capsule exerted external pressure on the eyeball and increased the incidence of loss of vitreous and prolapse of the iris. Because of this, carbon dioxide and then oxygen, both known to be absorbed more rapidly than air from tissues or closed spaces, were tried.

Air injected into Tenon's capsule was not absorbed completely for three to four days; most of it could still be seen at the end of 24 hours, and disappeared slowly thereafter. Carbon dioxide, on the other hand, was absorbed too rapidly to be effective as a contrast medium. Decreasing amounts of the gas were noted between the first and last exposure of a routine roentgenographic study. When, for technical reasons, the examination had to be repeated, there was barely enough carbon dioxide in Tenon's capsule to outline the globe.

Oxygen proved to be an ideal gas. It produced excellent visualization of the globe and was absorbed slowly enough to permit reëxamination when necessary; yet the oxygen was absorbed fast enough to avoid the risk of vitreous escape at operation.

The oxygen was obtained from an ordinary oxygen tank with a sterile rubber tube which contained a cotton filter. The oxygen was allowed to flow through the tubing for several seconds, after which it was introduced directly into the barrel of the syringe through the point for attachment of the needle, displacing the plunger as it entered the barrel. The needle was then quickly applied and the injection carried out.

R. W. Danielson.

Scott, G. I., and Michaelson, I. C. **An analysis and follow up of 301 cases of battle casualty injury to the eyes.** Brit. Jour. Ophth., 1946, v. 30, Jan., p. 42.

A rather complete array of facts and figures concerning 359 eyes injured in the Western Desert Campaign is presented, mostly in tabular form. Fifty-six eyes were enucleated within 2 to 3 days after injury; of the others, 190 had penetrating wounds, 52 had contused wounds, and 26 were injured by concussion. Grenades accounted for 25 percent of wounds, shells 24 percent, and gun shot 11 percent. Infection was minimal, whether penicillin or sulfonamides were used or not, and apparently these drugs were used very little. No cases of sympathetic ophthalmia occurred. Sixty-three percent of the men were returned to their units (loss of an eye did not make a man unfit for overseas service). Twenty percent had a final visual acuity of 6/12 or better, while 38 percent could only count fingers or less (half of this defective vision was probably due to cataract). Vitreous hemorrhage caused 60 percent of the defective vision below 6/60 and cataract 18 percent. Of the intraocular foreign bodies, 37 percent entered through the cornea, 33 percent the limbus and 25 percent the sclera. X-ray localization was accomplished by limbal rings sewed to the sclera. This method failed in only three cases, and in each the foreign body was behind the eye. Twenty eyes suffered double penetration, and retinal separation resulted in four of them. Concussion was much less destructive than contusion, and perforation was considerably more serious than either.

Morris Kaplan.

Struble, G. C., and Kreft, A. J. **War injuries of the eyes and visual pathways.** War Med., 1945, v. 8, Nov.-Dec., p. 290.

In World War I wounds of the eyes formed eight percent of all injuries, although the exposed surface of the eyes is only one four-hundredths of the total surface of the body. No figures for the present war are available. Factors accounting for this high figure are listed, and the nonocular wounds which affect the visual pathways are described in some detail. In 1918, Lagrange described a set of "laws" showing a constant, almost mathematical relationship between the type of orbital wound and the resultant type of ocular lesion. These rules apparently are just as applicable today, and several case reports are presented which bear this out. A strong plea is made for field studies of every patient receiving penetrating wounds of the head.

Included in the article is an interesting discussion of ballistics of wounds. A 115-grain Springfield rifle bullet leaves the gun with a velocity of 2,700 feet per second and rotates on its long axis 3,000 times per second. As it enters tissue it wobbles, often as much as 90 degrees. Its wounding effect is roughly 20,000 horsepower. Morris Kaplan.

Zorab, E. C. **War surgery of the eye in forward areas.** Brit. Jour. Ophth., 1945, v. 29, Nov., pp. 579-593.

A description of the work done in a mobile ophthalmic unit in the Mediterranean theatre of war is given and surgical procedures adopted in dealing with various eye injuries are outlined. An analysis of the 440 battle casualties requiring major operations between October, 1943, and October, 1944, is given. Twenty-eight and seven tenths percent of these eyes were irreparably damaged and removed. The brain was involved in 6 percent of the injuries and the accessory sinuses were involved in 12 percent. Panophthalmitis supervened in only 2.5 percent. Of 208 repairable eyes, 80 percent contained intraocular foreign bodies. In 43 percent of these the foreign bodies were removed by magnet; 16.7 percent were removed by the anterior route, 14.4 percent by the posterior route, and 69 percent through the wound of entry. Intraocular foreign bodies were removed by means other than the magnet in 10.8 percent. In 46 percent the intraocular foreign body was not removed.

Edna M. Reynolds.

17

SYSTEMIC DISEASES AND PARASITES

Arce, J. L. G. **The problem of diabetes in ophthalmology.** Bol. del Hosp. Oft. de Nuestra Señora de la Luz, 1945, v. 3, Sept.-Dec., pp. 110-120.

This general review of the subject deals with conditions in the eye directly resulting from diabetes and with the care to be taken of diabetic patients who require ocular surgery.

W. H. Crisp.

Bietti, G. B. **Fuller application of compulsory insurance against tuberculosis in the field of ophthalmology.** Trans. Soc. Oftal. Ital., v. 8, pp. 5-9.

Bietti urges greater use of tuberculosis sanitoriums in the treatment of ocular tuberculosis, especially in uveitis. Good results were reported from German and Swiss institutions from this treatment. Laws were passed in Italy in 1927, providing for insurance against tuberculosis and for the provision for such sanitoriums. From 0.5 to 2 percent of all clinic admissions are considered to be due to tuberculosis.

Favorable location of institutions, rest, good food, and removal from infected members of the family account for the better results of treatment of ocular tuberculosis. Eugene M. Blake.

Buxton, R. J. **Retinal haemorrhages in aplastic anaemia.** Brit. Jour. Ophth., 1945, v. 29, Dec., pp. 632-635. (See Section 10, Retina and vitreous.)

Dansey-Browning, G. C., and Rich, W. M. **Ocular signs in the prisoner of war returned from the Far East.** Brit. Med. Jour., 1946, v. 1, Jan. 5, p. 20.

Ocular studies were made on 30 prisoners who had suffered from dysentery (26 cases), malaria (15 cases), and beriberi (27 cases).

Ten cases of beriberi were discussed. The patients showed the following significant changes: Five had a color scotoma, and in five corrected vision was only 6/60. There was some pallor of the optic disc in both eyes of each patient; four had apparent primary optic atrophy, four showed pallor of the papillomacular bundle, and eight showed temporal pallor. In eight of the 10 patients there was evidence of bilateral retrobulbar neuritis, with a characteristic scotoma for white, but no peripheral constriction of the field or ocular-muscle paresis.

The author discusses the pathology, prognosis, and treatment of "dry" beriberi and vitamin deficiency.

There is a relationship between the scotoma of beriberi and that of toxic amblyopia. Deficiency of vitamins B_1 and B_2 plays a part in the ocular signs of beriberi, but the exact nature of the nutritional neuritis produced remains obscure.

The bilateral optic-nerve degeneration in this disease is more common than the literature leads one to believe, and though increased vitamin-B_1 intake improves peripheral nerve symptoms, the damage to the optic nerve is permanent. Francis M. Crage.

Donegan, E. A. **Ocular findings in tropical typhus.** Brit. Jour. Ophth., 1946, v. 30, Jan., p. 11.

Ocular findings in 101 cases of tsutsugamushi fever or scrub typhus in the India-Burma campaign are described. Conjunctival hyperemia, vitreous haze, mild hyperemia of the optic disc, and occasionally edema of the disc were seen. These signs persisted for two to three weeks and subsided.

Morris Kaplan.

Fanta, H. **Eye lesions in spotted typhus.** Klin. M. f. Augenh., 1943, v. 109, Jan.-Feb., p. 11.

Fanta reports the ocular lesions observed in a large number of patients (no figures given) in an army hospital in Poland. They were examined systematically during the period of fever and during convalescence. These examinations proved, contrary to various previous communications, that eye lesions are very common in spotted typhus and that practically all parts of the eye can be involved. In the beginning and during the course of the fever eye complications are often overlooked because of the severity of the general disease, and the absence of subjective eye disturbances. The first symptom is a conjunctival injection, and secretion is almost invariably present. It does not respond to treatment but usually disappears toward the end of convalescence, although about 10 percent of all patients suffer from a certain catarrhal condition for several weeks. In 87 percent of all cases there was a typical roseolar

rash in the lower fornix. Corneal lesions do not occur during the fever period; epithelial lesions with slightly diminished visual acuity occurred in only two patients. Iritis was observed in four patients during convalescence. Cataract was not seen, but moderate vitreous opacities occurred quite frequently. A few days after the onset of fever noticeable engorgement of retinal veins could be observed almost invariably, and it persisted for a long time, whereas changes of arterial vessels usually were absent during that period. During convalescence the arteries often showed typical signs of hypertension (silver-wire arteries, differences in caliber) accompanied by general hypertension. Petechial retinal hemorrhages along retinal vessels, usually in the periphery of the fundus and never noticed by the patient, were common. Measurements of the blood pressure in the central retinal artery often showed a market hypotension especially in patients with dimmed consciousness; this suggests connection with the encephalitic process which is often present. One patient suffered an extensive hemorrhage in the macula of one eye which caused a central scotoma and probably permanent damage. Blurring of the discs, starting during the fever period and often persisting through convalescence, was very common. In 40 percent of such patients the vision was moderately diminished and central scotoma for red and green was present. Fanta ascribes this defect to optic neuritis, in some of the patients, to true papilledema in others, and in some to a combination of both. Transient convergence pareses, often requiring prismatic corrections, occurred occasionally, and some doubtful cases of accommodative defects were observed. During the convalescent period many patients show a certain nervous irritability often accompanied by marked mydriasis, causing photophobia. Night blindness was never observed. (References.)

F. Nelson.

Grant, W. M. **Ocular complications of malaria.** Arch. of Ophth., 1946, v. 35, Jan., pp. 48-54.

Dendritic, or herpetic, keratitis is believed to be the most frequent ocular complication of malaria.

A type of corneal lesion referred to by most authors is described as a monocular interestitial process with clouding of the stroma but without vascularization.

A major proportion of the ocular complications which have been described in association with malaria are due to vascular and neurologic lesions. Lesions that result in loss of vision and are evident ophthalmoscopically are optic neuritis, atrophy of the optic nerve, and degenerative or hemorrhagic lesions of the retina and choroid.

Malaria may incite several characteristic disturbances in various parts of the eye. The lesions are usually monocular but moderately incapacitating. The relatively frequent complication of herpetic keratitis is nonspecific and several of the disturbances appear to be best explained on the basis of vascular lesions attributable to the malarial parasites. Lesions of the choroid, retina, and optic nerve, which from histologic evidence appear to be due to emboli of parasitized cells and which are commonly bilateral, are the most serious of the complications, because of their interference with vision. Treatment with antimalarial drugs has in general been successful in all the ocular disturbances except herpetic kera-

titis, which is caused by a virus, and for which specific chemotherapy is lacking. R. W. Danielson.

Knapp, A. A. **The eye as a guide to latent nutritional deficiency diseases: a clinical study of ocular diseases at an advanced base hospital in the Southwest Pacific.** Bull. New York Acad. Med., 1946, v. 22, April, p. 217.

A group of service men who had subsisted on a restricted diet, mostly canned foods, for 6 to 18 months in the Southwest Pacific, were studied. The most common complaint was impairment of vision, and homatropine refractions revealed axial myopia of +0.25 to +1.25 diopters. Many men complained of "inflamed eyes," and all were found to have mild vernal catarrh. The author implies that allergic conjunctivitis has a nutritional basis, and cites previous experiments in which this condition was helped by the use of calcium and vitamin D. A third complaint was "night blindness."

Objectively, the author noted blurring of the discs and a hazy fundus, but found normal blind spots, and normal perception of form and color. He believes that the fundoscopic findings mentioned may be signs of a latent deficiency state. In some patients enlargement of the blind spots with or without pallor of the disc was observed. The author ascribes these findings to retrobulbar neuritis, and states that the patients recovered after treatment of infectious foci and a nutritious diet. Chorioretinitis near the fovea was also reported; visual acuity in these patients was normal.

All the subjects of the study appeared healthy in other respects. Those with vernal catarrh, enlarged blind spots, pallor of the disc, and chorioretinitis are reported to have responded rapidly to diet. Neither the deficient diets nor the therapeutic diets which improved the patients were analyzed qualitatively or quantitatively. Benjamin Milder.

Macaskill, J. **Some ocular complications of scrub typhus.** Brit. Jour. Ophth., 1945, v. 29, Oct., pp. 537-540.

Scrub typhus is one of the typhus fevers endemic in Eastern Asia, due to larval mites that abound in areas of scrub jungle. The clinical features of the disease are fever, severe toxemia, headache, and prostration. Some patients become unconscious and others mentally disoriented. Diffuse glandular enlargement and a maculo-papular rash are common. The mortality rate is 10 to 15 percent. The Weil-Felix reaction is positive about the tenth day of the illness.

The essential pathologic change is a generalized vasculitis affecting the arterioles and smaller vessels. This results in destruction of the vessel walls with extravasation of blood into the surrounding tissues and vascular blockage either by thrombosis or cellular infiltrations. The lesions are patchily distributed throughout all organs and the central nervous system. Generalized congestion of the brain and meninges is commonly seen at post-mortem examination.

The ocular complications of 70 cases occurring in Assam are reviewed. Congestion of the conjunctiva occurred invariably in the acute phase of the disease. Subconjunctival hemorrhages were seen in four cases; in one there were extensive bilateral hemorrhages. Marked engorgement of the retinal vessels was noted in seven cases. Papilledema was present in four patients, and was bilateral in three of them. In these three there was an in-

crease in intracranial pressure associated with an increase in the protein content of the cerebrospinal fluid. Retinal hemorrhages occurred in four cases. One case of bilateral optic atrophy was seen six months after the acute stage of illness.

The visual fields of the patient with optic atrophy are given and the course of his illness is described. The author believes that the optic atrophy was toxic in origin, and he mentions that many patients have a nerve deafness, that is probably also toxic in origin. (Fields.) Edna M. Reynolds.

Miller, C. D., and McIntyre, D. W. **A syndrome termed Reiter's disease (urethritis, conjunctivitis, and arthritis).** Ann. Int. Med., 1945, v. 23, Oct., p. 673. (See Section 5, Conjunctiva.)

Posner, M., and Horrax, J. **Eye signs in pineal tumors.** Neurosurgery, 1946, v. 3, January, p. 15.

Pineal tumor is rare. Its symptoms resemble closely those of cerebellar neoplasm. An exact evaluation of characteristic eye signs and ventriculograms, however, lead to an early, correct diagnosis. Subtemporal decompression followed by irradiation is satisfactory therapy.

Compression and obstruction of the aqueduct of Sylvius will cause headache, nausea, vomiting, and papilledema. Pressure of the tumor on the corpora quadrigemina results in central deafness and gives rise to the following eye signs: (1) impaired pupillary reactions; (2) limitations of extraocular movements, especially conjugate movements upward; (3) nystagmus; (4) strabismus. Pressure on the tentorium gives rise to cerebellar signs. General examination often reveals endocrine dysfunction in the form of macrogenitosomia praecox, diabetes insipidus or dystrophia adiposogenitalis.

In 16 cases of pineal tumor, dilated pupils were present in 31 percent; there was impaired reaction to light in 50 percent; reaction of the pupils in accommodation was impaired in 12 percent; papilledema was present in 56 percent; and upward gaze was limited in 31 percent. R. Grunfeld.

Ridley, Harold. **Ocular manifestations of malnutrition in released prisoners of war from Thailand.** Brit. Jour. Ophth., 1945, v. 29, Dec., pp. 613-618.

A report of the examinations of the eyes of 500 released allied prisoners of war and internees from Thailand, whose sight had deteriorated during captivity, is given. The food was inadequate in quantity and deficient in protein, fats, and vitamins. The three daily meals were the same and consisted almost entirely of carbohydrates. From October, 1942, to March, 1943, everyone was forced to labor from dawn to dusk on building the Bangkok-Moulmein railway. The food was reduced to starvation level, and for a time only rice and salt were supplied. Most of the visual disorders originated during or shortly after this period.

One hundred of these patients were amblyopic. In many of them the onset was sudden, and maximum disability was reached within a single day, but in others it was gradual, taking months to develop. Rather surprisingly there were few complaints of hemeralopia. Intercurrent infections tended to precipitate amblyopia. Many patients with amblyopia also suffered from pellagra, edema of the legs, beriberi, sore tongue, and perleche. Quite a high proportion of the amblyopic were also nerve deaf. There were 48 cases of optic

atrophy and 30 were regarded as doubtful. In some instances of severe and prolonged amblyopia, no abnormalities were visible.

Campimetry in 90 patients revealed a small, sharply demarcated central scotoma, very dense but rarely more than 3 degrees and often only 1 degree or less from the fixation point. In the majority of these cases, there was a history of considerable improvement during captivity.

Practically all the released prisoners showed some degree of keratoconjunctival abnormality. In 96 percent of the amblyopic patients and in 91 percent of the other patients there was limbal vascularization accompanied by opacification. The limbal capillaries frequently formed aneurysms so large that they could be mistaken for hemorrhages.

All the ex-prisoners were unduly presbyopic.

Amblyopic patients are still arriving at the rate of about five in a day, and it is possible that 1 percent of the survivors from Japanese prison camps may be permanently disabled by defective sight. Edna M. Reynolds.

Rosen, Emanuel. **Diabetic needles.** Brit. Jour. Ophth., 1945, v. 29, Dec., pp. 645-653. (See Section 9, Crystalline lens.)

Semadeni, B. **Histological findings in a patient with numerous microfilarias in both eyes.** Klin. M. f. Augenh., 1943, v. 109, Jan.-Feb., p. 35.

A man, 39 years of age, who had spent the years 1936 and 1937 in the Sudan and Algeria, developed burning and redness of the eyes, zoster-like skin eruptions that suggested herpes zoster, disturbances of temperature sense, swellings about nose and ears, diarrhea, and night sweats. In 1939, an eosinophilia of 28 percent was detected and a slitlamp examination revealed about 300 live microfilarias, 0.2 mm. in length, in the anterior portion of the parenchyma of each cornea. Five to 20 of the parasites could be observed in active movement in the aqueous, especially after exposure of the eye to light (positive phototropism.) In excised pieces of skin from the ear and neck the parasites could be identified histologically as larvae of Onchocerca volvulus. Nowhere could the adult parasites be detected. Various therapeutic measures were applied unsuccessfully. The patient died after an accident in October, 1941. Histologic examination of the eyes showed cellular infiltrations in the cornea, conjunctiva, episclera, and the superficial layers of the sclera; also a little in the ora serrata and the choroid. The parasites are most numerous in the eye where lymph spaces are found.

F. Nelson.

Sautter, Hans. **Spotted typhus and eye.** Klin. M. f. Augenh., 1943, v. 109, Jan.-Feb., p. 24.

The clinical records of two patients with simple unilateral incomplete optic atrophy with contraction of visual fields after spotted typhus are reported. The histologic findings in three pairs of eyes enucleated *post mortem* are also reported; the conjunctiva was hyperemic, there was subepithelial, cellular lymphocytic infiltration, and an increase in number of beaker cells. Similar cellular infiltration was found in the iris and ciliary body, but there was no exudation into the anterior chamber and vitreous body. In all specimens the the choroid was hyperemic, thickened, and massively infiltrated, chiefly in the choriocapillaris. There were incipient thrombi in some veins. Invariably a

strong cellular infiltration was found in the optic nerve and its sheath, and papilledema, which spread into the retina. The latter was hyperemic in the vicinity of the nerve head. Hemorrhages and other changes were usually absent in the retina. An infiltrative retinal focus was found in only one eye. The muscles also showed small-celled interstitial, perivascular infiltration. (References.) F. Nelson.

Sen, K., and Ghose, N. **Ocular gnathostomiasis.** Brit. Jour. Ophth., v. 29, Dec., 1945, pp. 618-626.

A case of gnathostoma in the human eye is reported. A brief description of the life cycle and habitat of the worm is given.

The patient was a Hindu Brahmin, 26 years of age, who was admitted into the Eye Infirmary for treatment of orbital cellulitis with hemorrhages in the retina and the vitreous of his left eye.

He reported that 10 days before admission he had felt a dull aching pain on the left side of his nose. The next day the pain increased, and an itching swelling appeared on the left cheek and lower eyelid. It increased until he could not open his left eye.

Examination revealed chemosis of the conjunctiva and restriction of movements of the eyeball. The pupil was dilated and reacted to light sluggishly. The tension was normal, and the vision 6/6. The right eye was normal. Two days later the swelling of the lids and the chemosis of the conjunctiva had almost disappeared, but the pain was more severe in the eye, and the vision was reduced to perception of hand movements. The fundus showed a hazy vitreous with engorgement of the retinal veins and hemorrhages in the retina. The patient was admitted to the hospital. General examination revealed a moderate anemia and slight eosinophilia. He developed an iritis which responded to the usual treatment, but later the iritis recurred with increased tension and one of the nodules in the iris was seen to be moving. Slitlamp examination showed the presence of a worm in the eye. This was removed and found to be about 4 mm. long and completely covered with iris pigment.

When it was possible to see the fundus, a circular gray area below the macula was made out, probably the site of the worm's entrance into the eye.

The patient made an uneventful recovery but optic atrophy developed. (3 illustrations, references.)

Edna M. Reynolds.

Thannhauser, S. J. **Werner's syndrome (Progeria of the adult) and Rothmund's syndrome; two types of closely related heredofamilial atrophic dermatoses with juvenile cataracts and endocrine features.** Ann. Int. Med., 1945, v. 23, Oct., p. 559. (See section 9, Crystalline lens.)

Zeeman, W. P. C. **Gargoylism.** Acta Ophth., 1942, v. 20, pt. 1, pp. 40-47.

A child, aged 6½ years, with gargoylism came to autopsy. The lesions in the central nervous system resembled those of amaurotic family idiocy. The corneal lesion, which is described in detail, is strikingly similar to that reported by Berliner, in 1939, under the name of lipin keratitis of Hurler's syndrome (6 photomicrographs). Ray K. Daily.

18

HYGIENE, SOCIOLOGY, EDUCATION, AND HISTORY

Ayesworth, F. A. **Causes of blindness in over 12,000 cases.** Canadian

Med. Assoc. Jour., 1946, v. 54, Jan., p. 30.

In this blind population the visual acuity varies from no light perception to 6/60. The latter is the upper limit for economic blindness accepted by the pension authorities.

Both topographic and etiologic classifications are given. Glaucoma is the cause of the largest number of cases of blindness and myopia of the second largest. Numerous other causes are mentioned.

The author suggests that every individual between the ages of 40 and 50 years undergo an examination under a cycloplegic for early diagnosis and prophylaxis against blindness.

Francis M. Crage.

Fishenden, R. B. **Types, paper, and printing in relation to eyestrain.** Brit. Jour. Ophth., 1946, v. 30, Jan., p. 20.

A description of the various types of lettering used in printing (in England) and of the effects of various kinds of paper on legibility is presented. Some of the details of the lettering are analyzed. No definite conclusions as to the effect on eyestrain or on vision seem to have been reached.

Morris Kaplan.

Fox, M. J., and Bortin, M. M. **Rubella in pregnancy causing malformations in newborn.** Jour. Amer. Med. Assoc., 1946, v. 130, March 2, pp. 568-569.

The writers' investigation is based on the records of the Public Health department of the city of Milwaukee. It covers a 3-year period and includes all married women who were pregnant at the time they had rubella. The results of investigations of the occurrence of congenital malformation in babies born by mothers who had rubella in the early months of pregnancy appears in tabulated form. The writers state that their records do not justify the termination of pregnancy in women who have rubella. The occurrence of congenital malformations in virus diseases in pregnant women is, however, a subject worthy of further careful investigation. M. Lombardo.

Hathaway, Winifred. **The partially seeing child in 1950.** Sight-Saving Rev., 1945, v. 15, Fall, p. 156.

The author sees much hope for the visually handicapped child, whose number will probably decrease now that most states have sane premarital and prenatal laws. Interstitial keratitis and ophthalmia neonatorum may be expected to disappear, and with sulfonamides, penicillin, and corneal transplants widely used few children should be sightless. Increased research in nutrition and in lighting should also bring benefit. Better training of teachers is predicted, and increased use of sound and radio in teaching should make the education of the visually handicapped equal to that of the normal child. Morris Kaplan.

Henderson, J. W. **Overseas ophthalmology.** Amer. Jour. Ophth., 1946, v. 29, May, pp. 551-562.

Nicholls, J. V.V. **Ophthalmic status of Cree Indians.** Canadian Med. Assoc. Jour., 1946, v. 54, April, p. 344.

Three hundred Cree Indians, of Northern Manitoba, were surveyed to determine the type and frequency of ocular diseases. These people are subjected to prolonged exposure to cold and wind, and subsist on a diet poor in fresh vegetables, dairy products, and meat. The most frequent abnormality was pterygium, and its incidence increased with each decade. Pinguecula was common; retinal arteriosclerosis

was rare. A relatively greater incidence of visual defects among the adults of the group, as compared with other adult groups, was ascribed to the higher percentage of organic ocular disease.

Benjamin Milder.

Minton, Joseph. **The one-eyed worker.** Sight-Saving Rev., 1945, v. 15, Fall, p. 161.

One-eyed people are divided into two groups: those who have lost an eye in childhood, and those who have lost an eye in adult life through disease or injury. The first group is not handicapped, whereas the second group has much readjusting to accomplish. Most men interviewed (at the Royal Eye Hospital, London) had lost an eye while hammering, chipping, boring, or milling. The most difficult part of readjustment was that involving depth perception, although all, sooner or later, apparently overcome this problem. If the lost eye was the dominant eye the problem is greatly exaggerated; it is equally minimized if the dominant eye is retained. The author discusses reëmployment opportunities and stoutly insists that, although the one-eyed worker is actually fit for most jobs, the safety of the remaining eye should be the first consideration, and he should certainly not be returned to his previous job if the likelihood of injury remains.

Morris Kaplan.

Queiroga, Geraldo. **Teaching of ophthalmology in the United States.** Rev. Brasileira de Oft., 1945, v. 4, Dec., pp. 77-88. (See Amer. Jour. Ophth., 1946, v. 29, p. 512.)

Rycroft, B. W. **Ophthalmology in the B.N.A. and C.M. forces.** Brit. Jour. Ophth., 1945, v. 29, Nov., pp. 594-607.

A description of the military administration of the campaign in North Africa is given. The ocular diseases related to the terrain and the subtropical climate of North Africa are discussed, and methods of treatment are outlined. The treatment of battle casualties is also described.

The changes made in the ophthalmic and optical services in the campaign in Sicily and Italy are described, and the memorandum which was issued to medical officers for the preliminary care of ophthalmic cases is given together with the general and special instructions to medical officers for the care of eyes.

The Livingstone hand electromagnet and a portable giant-magnet stand, as well as the antimine perspex visor, are examples of the successful research that was carried out during the campaigns.

In the Sicilian and Italian campaigns the giant magnet was applied to all penetrating wounds of the eye as soon as possible after injury. In this way, 50 to 60 percent of all magnetizable foreign bodies were removed in good time.

Deep intraocular infections were treated with penicillin, which is a great advance in the prevention and treatment of ocular sepsis.

The Lister frill excision for disorganized eyes was carried out when these were seen at an early stage. At later stages, enucleation with the implantation of a 14-mm. perspex globe in Tenon's capsule was done. The old evisceration operation was practically discarded, and enucleation alone was very infrequent. To clean up dirty sockets, 2-percent silver nitrate paint and penicillin together with adhesive straps on the upper lid to allow the ingress of air proved very successful. (5 illustrations.) Edna M. Reynolds.

"Screening," eye examinations, and follow-up. Sight-Saving Rev., 1945, v. 15, Fall, p. 132.

A comprehensive public-health eye program for large groups is presented. The program includes early discovery through periodic screening of groups of individuals, comprehensive eye examination for each one who seems to have any visual or eye difficulty, and a follow-up system to aid in securing eye examinations and in carrying out recommendations.

Screening tests suggested are: Snellen test for distance, plus-lens test for hyperopia, tests for near vision, rough visual fields, muscle balance, color vision, depth-perception tests, and stereoscopic-vision test. That the accomplishment of all these on all the people would be extremely difficult is admitted, but it is an ideal to strive for.

Morris Kaplan.

19

ANATOMY, EMBRYOLOGY, AND COMPARATIVE OPHTHALMOLOGY

Kiss, F. **The blood circulation of the eye.** Ophthalmologica, 1943, v. 106, Nov.-Dec., pp. 226-250. (See Section 7, Uveal tract, sympathetic disease, and aqueous humor.)

NEWS ITEMS

Edited by DONALD J. LYLE, M.D.
904 Carew Tower, Cincinnati 2

News items should reach the editor by the twelfth of the month.

DEATHS

Dr. William Byron Agan, Brooklyn, New York, died February 5, 1946, aged 58 years.

Dr. M. Fullenwider, Muskogee, Oklahoma, died January 26, 1946, aged 67 years.

Dr. Edward Stieren, Pittsburgh, Pennsylvania, died January 8, 1946, aged 72 years.

Dr. James Watson White, Albany, New York, died May 15, 1946, aged 69 years.

MISCELLANEOUS

Four scholarships for the advanced study of eye diseases at New York University College of Medicine will be provided annually by the Lions Club of New York, it was announced May 14th. The scholarships will be valued at $500 each and will be available to four graduate medical students to be selected by the department of ophthalmology of the medical school, enabling them to have a year of advanced study.

The Rochester Orthoptic Center is receiving applications for its next training course for orthoptic technicians. This course is accredited by the American Orthoptic Council. Information may be received from the Rochester Orthoptic Center, 208 North Goodman Street, Rochester 7, New York.

The Post-Graduate School of the University of Southern California School of Medicine is presenting a six-months' basic course in ophthalmology starting May 20th. Dr. A. Ray Irvine, professor of ophthalmology, is director of the course; he is assisted by Drs. Maurice Beigelman, William Endres, and S. Rodman Irvine.

The entire first month was devoted to preclinical courses organized as follows: Anatomy, Dr. Paul R. Patek; Physiology, Dr. Douglas Drury; Pathology, Dr. Ernest Hall; Bacteriology, Dr. John F. Kessel; Pharmacology, Dr. Clinton Thienes; Biochemistry, Dr. Harry Deuel, Jr. During the *second month* mornings are devoted to Histopathology and afternoons to intensive work in Physiological optics.

The 3d, 4th, and 5th months will stress Clinical ophthalmology and Refraction. Clinical instructors include: Drs. C. H. Albaugh, Louis Bloomberg, John Bullis, Daniel B. Esterly, Channing Hale, Deane C. Hartman, W. C. Irvine, Raphael Koff, George B. Landegger, John P. Lordan, Henry R. Nesburn, Robert A. Norene, M. W. Nugent, Stephen Popovich, Helen Preston, Alfred R. Robbins, Carroll Weeks, Clinton A. Wilson, Warren C. Wilson, Miss Dorothy Franklin, Mr. Russell Stimson, and Miss Dorothy Bergin.

Dr. Dwight Trowbridge of Fresno will be responsible for the section on Neuroöphthalmology. *The 6th month* will be spent in review with emphasis on preparation for the American Board Examinations.

Problem cases in Refraction and Therapeutics will be presented. Among several nationally known ophthalmologists who will be available during this final month for short series of lectures are Dr. Phillips Thygeson and Dr. Meyer Wiener. Examinations will be given at the end of each month. Sixteen students are enrolled, all of them returned service men. Enrollment was limited mainly by restricted facilities for work in refraction. Coöperation of the administrative and eye staffs of the Los Angeles County General Hospital is appreciated as essential to the success of the course.

As the guest of Emory Univerity, 155 ophthalmologists from 19 states gathered recently at a unique and outstanding ophthalmologic seminar honoring the memory of Dr. Abner Wellborn Calhoun.

The University invited six of the nation's prominent ophthalmologists to be its guest speakers during the three-day session opening April 4th. Their presence in addition to that of the other guests was testimony to the memory of Dr. Calhoun, the first teacher of ophthalmology in the South and an outstanding ophthalmologist until his death in 1910. He was a professor of ophthalmology and otolaryngology in the Atlanta Medical College, which later became affiliated with Emory University, and the University chose this unique seminar to honor his memory.

During the three days 15 papers on ophthalmologic subjects were presented. The guests were entertained at luncheons and dinners by the University, the Board of Trustees of Grady Hospital, and by the University's Department of Ophthalmology.

At the opening dinner, Dr. Frank B. Walsh, associate professor of ophthalmology at Johns Hopkins University, presented a paper on "Myasthenia gravis." Following, was an address on "Medical ophthalmology" by Dr. Walter I. Lillie, professor of ophthalmology at Temple University.

The April 5th session opened at Grady Municipal Hospital with which Emory University is affiliated and at which it does most of its bedside medical teaching. Before an audience which

overflowed the new Colored Nurses' Auditorium, Dr. William Benedict, chief of the Eye Section of the Mayo Clinic, presented a paper on "The clinical meaning of exophthalmos."

A noon recess permitted the entire group to inspect the Emory University department of ophthalmology at Grady Hospital, including the well-organized Colored Eye Department and the eye clinic in the white section. They also inspected the complete eye pathologic laboratory, one of the first in the South. The department has a chief, four assistant professors, four instructors, plus one full-time instructor; it is combined with ear, nose, and throat work. (Its three-year service with six men on the services gives outstanding training to its graduates.)

At the Academy of Medicine, Dr. Derrick Vail, professor of ophthalmology at Northwestern University, presented his paper on "Eye changes in diabetes," followed by Dr. Frank B. Walsh speaking on "Naso-pharyngeal tumors."

After a dinner as guests of Emory University, the 152 attendants heard Dr. Parker Heath, professor of ophthalmology at Wayne University, deliver a paper on "Ocular therapeutics in glaucoma." He was followed by Dr. John Dunnington, professor of ophthalmology of the College of Physicians and Surgeons, Columbia University, whose subject was "The treatment of detachment of the retina."

On the final morning Dr. Benedict spoke on "Glaucoma in diabetes," and Dr. Dunnington on the "Surgical treatment of the vertical deviations." The University's ophthalmology department was host at a luncheon.

Afternoon papers were delivered by Drs. Heath, Walsh, and Lillie. That evening Dr. Benedict spoke on "Preparation of the patient for cataract operation," and Dr. Vail on "The circulation of the optic nerve and its influence on disease."

The entire meeting was said to be remarkable in the uniformly high attendance by all guests. It was one of the rare seminars sponsored in the South by an entire university rather than exclusively by one individual or department.

The thirty-second annual meeting of the Oxford Ophthalmological Congress was held on July 4 to 6, 1946, at the Department of Human Anatomy, Oxford, by kind permission of Prof. Le Gros Clark. Accommodation was secured at Keble College, and the Warden kindly agreed to include lady members as residents in College. Members met informally at supper on Wednesday, July 3d, at 7:45 p.m. in the Hall of Keble.

The Congress opened with a discussion on "Amblyopia" led by Mr. Philip Jameson-Evans and Mrs. Dorothy Campbell. The Doyne Memorial Lecture, entitled "The state of the retina in diabetes mellitus," was delivered by Prof. Arthur J. Ballantyne. Facilities were provided in the Museum for demonstrations, and members were invited to bring forward cases, specimens, instruments, apparatus, and other matters, of ophthalmologic interest. Orthoptists were granted the privilege of attending the Congress as visitors on invitation of a member at sessions in which subjects affecting their department were discussed.

Societies

The following officers were recently elected by the New York Society for Clinical Ophthalmology: president, Dr. Benjamin Friedman; vice-president, Dr. Daniel Kravitz; recording secretary, Dr. Bernard Kronenberg; corresponding secretary, Dr. Benjamin Esterman; treasurer, Dr. Leon Ehrlich.

At its annual meeting on May 28, 1946, the Milwaukee Oto-Ophthalmic Society elected the following officers: president, Dr. Meyer Fox; vice-president, Dr. Frank G. Treskow; secretary-treasurer, Dr. Earl W. Mertens; directors, Drs. Ralph T. Rank, Thomas McCormick, and Herbert Schmidt.

The Reading Eye, Ear, Nose, and Throat Society has distributed its War Fund, both principle and interest, as outright gifts to its members who were in the Armed Forces. Each one was given $644.

Personals

Dr. Lawrence T. Post, professor and head of the department of ophthalmology, Washington University School of Medicine, St. Louis, delivered the Edward Jackson Memorial Lecture on April 19th at the University of Colorado School of Medicine, Denver, under the auspices of the Medical Society of the City and County of Denver. His subject was "Changing eyes in a changing world."

At the meeting of the Western Association of Industrial Physicians and Surgeons on June 30th, in San Francisco, Dr. Hedwig S. Kuhn of Hammond, Indiana, presented a paper on "Right eyes for the job."

Dr. David F. Gillette, professor of ophthalmology of Syracuse University College of Medicine, became professor emeritus on July 1st. Dr. Harold H. Joy has been appointed professor of ophthalmology to succeed him.

At a special session of the Minnesota Academy of Ophthalmology and Otolaryngology, at the 93d annual session of the Minnesota State Medical Association in St. Paul, on May 20th, Dr. Elmer A. Vorisek presented a paper on "Evaluation of the newer therapeutic agents in ophthalmology." This paper has been accepted for publication in the Journal.

Look for This Sign GUILD OPTICIANS *or consult classified telephone directory*

OFFICIAL DIRECTORY

Guild Opticians

CALIFORNIA
Los Angeles
HEIMANN & MONROE
(3 Stores)
Modesto
FRANKLIN OPTICAL CO.
Oakland
FRANKLIN OPTICAL COMPANY
(5 Stores)
Pasadena
ARTHUR HEIMANN
Richmond
FRANKLIN OPTICAL CO.
San Francisco
JOHN F. WOOSTER CO.
Santa Barbara
SANTA BARBARA OPTICAL CO.
Vallejo
FRANKLIN OPTICAL CO.

COLORADO
Denver
SYMONDS-ATKINSON OPTICAL CO.

CONNECTICUT
Bridgeport
FRITZ & HAWLEY
BERNARD J. O'DONNELL, OPTICIAN
THE HARVEY & LEWIS CO.
WAKEMAN & ANDERSON
New Britain
THE HARVEY & LEWIS CO.
New Haven
FRITZ & HAWLEY
THE HARVEY & LEWIS CO.
CONRAD KASACK
Hartford
LOWRY & JOYCE
THE HARVEY & LEWIS CO.
Waterbury
WILHELM, INC.

DELAWARE
Wilmington
THE BAYNARD OPTICAL CO.
CHAS. M. BANKS OPTICAL CO.
CAVALIER & CO.

DISTRICT OF COLUMBIA
Washington
EDMONDS, OPTICIAN (3 Stores)
FRANKLIN & CO.
HUFFER-SHINN OPTICAL CO.
MEDICAL CENTER OPTICIANS
RHODES, OPTICIAN
TEUNIS BROTHERS

FLORIDA
Jacksonville
JACKSON OPTICAL DISPENSARY
Miami
HAGELGANS OPTICAL CO.

GEORGIA
Atlanta
WALTER BALLARD OPT. CO.
(3 Stores)
KILBURN'S
KALISH & AINSWORTH, INC.
Augusta
TWIGGS PRESCRIPTION OPTICIANS
Macon
W. B. KELLY, OPTICIAN

IDAHO
Boise
GEM STATE OPTICAL CO.

ILLINOIS
Chicago
ALMER COE & CO.
J. H. STANTON
Evanston
ALMER COE & CO.

KENTUCKY
Louisville
THE BALL OPTICAL CO.
SOUTHERN OPTICAL CO.
(3 Stores)
MUTH OPTICAL CO.

LOUISIANA
New Orleans
HELMUTH HORNUFF, OPTICIAN

MARYLAND
Baltimore
BOWEN & KING, INC.
D. HARRY CHAMBERS, INC.
ALFRED A. BURKE

MASSACHUSETTS
Boston
CHILDS, CARL G.
DAVIDSON & SON
EDWARD W. HELDT.
MONTGOMERY FROST CO.
(4 Stores)
ANDREW J. LLOYD CO. (3 Stores)
HENRY O. PARSONS
Cambridge
ANDREW J. LLOYD COMPANY
Framingham
THE OPTICAL CO.
Greenfield
SCHAFF, OPTICIAN
Springfield
J. E CHENEY & STAFF, INC.
CLARKE, ALBERT L.
THE HARVEY & LEWIS CO.
Waltham
BENNET B. O'NEIL, OPTICIAN
Woburn
ARTHUR K. SMITH
Worcester
JOHN C. FREEMAN & CO.
THE HARVEY & LEWIS CO.

MICHIGAN
Ann Arbor
STOWE OPTICIAN

MINNESOTA
Minneapolis
M. J. CARTER
Rochester
A. A. SCHROEDER
St. Paul
ARTHUR F WILLIAMS

MISSOURI
St. Louis
GEO. D. FISHER OPTICAL CO.
(3 Stores)
EIKER BROS. OPTICAL CO.
(3 Stores)
JOHN A. GUHL, INC.

NEW JERSEY
Asbury Park
ANSPACH BROS.
Atlantic City
ATLANTIC OPTICAL CO.
FOERSTER OPTICAL CO.
FREUND BROTHERS
Camden
E. F. BIRBECK CO.
HARRY N. LAYER
J. E. LIMEBURNER CO.
PELOUZE & CAMPBELL
East Orange
ANSPACH BROS.
H. C. DEUCHLER
Elizabeth
BRUNNER'S
Englewood
HOFFRITZ, FRED G.
Hackensack
HOFFRITZ & PETZOLD
Jersey City
WILLIAM H. CLARK
Montclair
STANLEY M. CROWELL CO.
MARSHALL, RALPH E.
Morristown
JOHN L. BROWN
Newark
ANSPACH BROS.
KEEGAN, J. J.
REISS, J. C.
CHARLES STEIGLER
EDWARD ANSPACH
Paterson
COLLINS, J. E.
Plainfield
GALL & LEMBKE
LOUIS E. SAFT
Ridgewood
RAY GRIGNON, OPTICIAN
Summit
ANSPACH BROS.
H. C. DEUCHLER
Trenton
GEORGE BRAMMER, OPTICIAN
Union City
ARTHUR VILLAVECCHIA
Westfield
BRUNNER'S

NEW YORK
Albany
FERRIN & DI NAPOLI
Babylon
PICKUP & BROWN, INC.
Baldwin, L. I.
FRANCIS D. GILLIES
Brownville
SCHOENIG & CO., INC.
Buffalo
BUFFALO OPTICAL CO. (3 Stores)
GIBSON & DOTY
FORREST-GOULD OPTICAL CO.
FRANK & LEIBWING OPT. CO.
PRECHTEL OPTICAL CO.
SCHLAGER & SCHLAGER
FOX & STANILAND, INC.
(2 Stores)
URSIN-SMITH GUILD OPTICIANS
VANDERCHER
Kenmore
BUFFALO OPTICAL CO
GIBSON & DOTY
New Rochelle
BATTERSON, INC., JOHN P.
New York City
AITCHISON & CO.
EDWARD J. BOYES
CLAIRMONT & NICHOLS CO.
FRYXELL & HILL
GALL & LEMBKE
HALPERT & FRYXELL, INC.
HARTINGER, EDWARD T.
A. HAUSTETTER, INC.
HOAGLAND, J. S.
LUGENE, INC. (2 Stores)
MARTER & PARSONS
E. B. MEYROWITZ, INC.
(6 Stores)
H. L. PURDY, INC.
SCHOENIG & CO., INC.
Brooklyn
BADGLEY, H. C.
BECHTOLD & CO., INC.
DOUDIET, ERNEST A.
J. B. HOECKER, INC.
E. B. MEYROWITZ, INC.
J. H. PENNY, INC.
A. M. SHUTZ
V. E. TEDESCO
Flushing
BERNARD SHOLKOFF
Homestead
C. WALTER SEE
Rockville Center
SCHOENIG & CO., INC.
Staten Island
VERKUIL BROTHERS
Jamaica, L. I.
HANSEN, JOHN
Niagara Falls
GEORGE OPTICAL CO.
Rochester
WILLIAM J. HICKEY
WHELPLEY & PAUL
WALDERT OPTICAL CO.
Rye
A. E. REYNOLDS
Schenectady
DAY, JAMES E.
OWEN OPTICAL COMPANY
Syracuse
CARPENTER & HUGHES
CLOVER-WHITE OPT. CO.
EDWARD HOMMEL & SONS
Troy
WILLIAMS—OPTICIAN
Watertown
ROBERT L. MEADE
White Plains
JOSEPH E. KELLY
CLAIRMONT & NICHOLS CO.
SAMUEL PEYSER
Yonkers
PROFESSIONAL OPTICAL SHOP

OHIO
Akron
VORWERK PRESCRIPTION OPTICIANS
Cincinnati
ETTER BROTHERS
KOHLER & CO.
SOUTHERN OPTICAL CO.
TOWER OPTICAL CO.
Cleveland
CHARLES F. BANNERMAN
E. B. BROWN OPTICAL CO.
RICHARD H. EBNER
HABERACKER OPTICAL CO.
REED & McAULIFFE, INC.
HENRY J. PORTER
Lakewood
HABERACKER OPTICAL CO.
REED & McAULIFFE, INC.
Toledo
PRESTON SADLER

OREGON
Portland
MOOR, HAL H.

PENNSYLVANIA
Allentown
L. F. GOODIN
Ardmore
WALL & OCHS
WINFIELD DONAT CO.
Bethlehem
PRICE, WILLIAM H.
Bryn Mawr
J. E. LIMEBURNER CO.
Erie
HESS BROS.
WILLIAM J. MAGAT CO.
E. K. MEYERS
ERIE OPTICAL CO.
Homestead
L. E. NEWLAND II, OPTICIAN
Jenkintown
WINFIELD DONAT CO.
J. E. LIMEBURNER CO.
Norristown
J. E. LIMEBURNER CO.
Philadelphia
BENDER & OFF
BONCHUR & HOLMES, INC.
(2 stores)
A. W. BRAEUNINGER, INC.
JOSEPH F. CLEARY
WINFIELD DONAT CO. (3 Stores)
DOYLE & BOWERS
JOSEPH C. FERGUSON, JR., INC.
KEENE & CO.
J. E. LIMEBURNER CO. (3 Stores)
RALPH H. MACMURTRIE
MAWSON & KIENLE
FRANK A. MORRISON
MULLEN & WOLF
MULLER & FENTON
WILLIAM J. SCOTT, INC.
THE WM. F. REDMOND CO.
SIGISMUND
STREET, LINDER & PROPERT
WALL & OCHS (3 Stores)
WELSH & DAVIS
WILLIAM S. REILLY
WILLIAMS, BROWN & EARLE, INC.
JOSEPH ZENTMAYER
Pittsburgh
GEO. B. REED & CO.
DAVIDSON & CO.
DUNN-SCOTT CO.
GEO. W. HAAS, INC.
B. K. ELLIOTT CO.
F. J. MALONEY
OSCAR P. MATOUS, OPTICIAN
CHARLES F. O'RANLON
SHALER & CRAWFORD, INC.
HOMER J. SABISH, OPTICIAN
Upper Darby
J. E. LIMEBURNER CO
West Chester
WINFIELD DONAT CO.
Wilkinsburg
DAVIDSON & CO.

NORTH CAROLINA
Fayetteville
McBRYDE'S—OPTICIANS

VIRGINIA
Lynchburg
BUCKINGHAM & FLIPPIN
A. G. JEFFERSON
Newport News
WHITE OPTICAL CO.
Norfolk
E. E. BUSHANS OPTICAL CO. INC.
SMITH & JOHNSON OPTICAL CO., INC.
Portsmouth
JOHNSON OPTICAL CO.

WASHINGTON
Seattle
CHARLES R. OLMSTEAD
WESTERN OPTICAL DISPENSARY
Yakima
PHYSICIANS OPTICAL CO.

WEST VIRGINIA
Charleston
S. A. AGNEW

CANADA
Hamilton
W. E. DAVIES
Montreal
R. N. TAYLOR & CO., LTD.
Ottawa, Ontario
O. L. DEROUIN
GEO. R. NELMS
SUTHERLAND & PARKIN
Toronto
FRED SHORNEY, LTD.
J. O. WILLIAMS
Winnipeg
RAMSAY, ROBERT S.